Power Engineering

MAY, 1952

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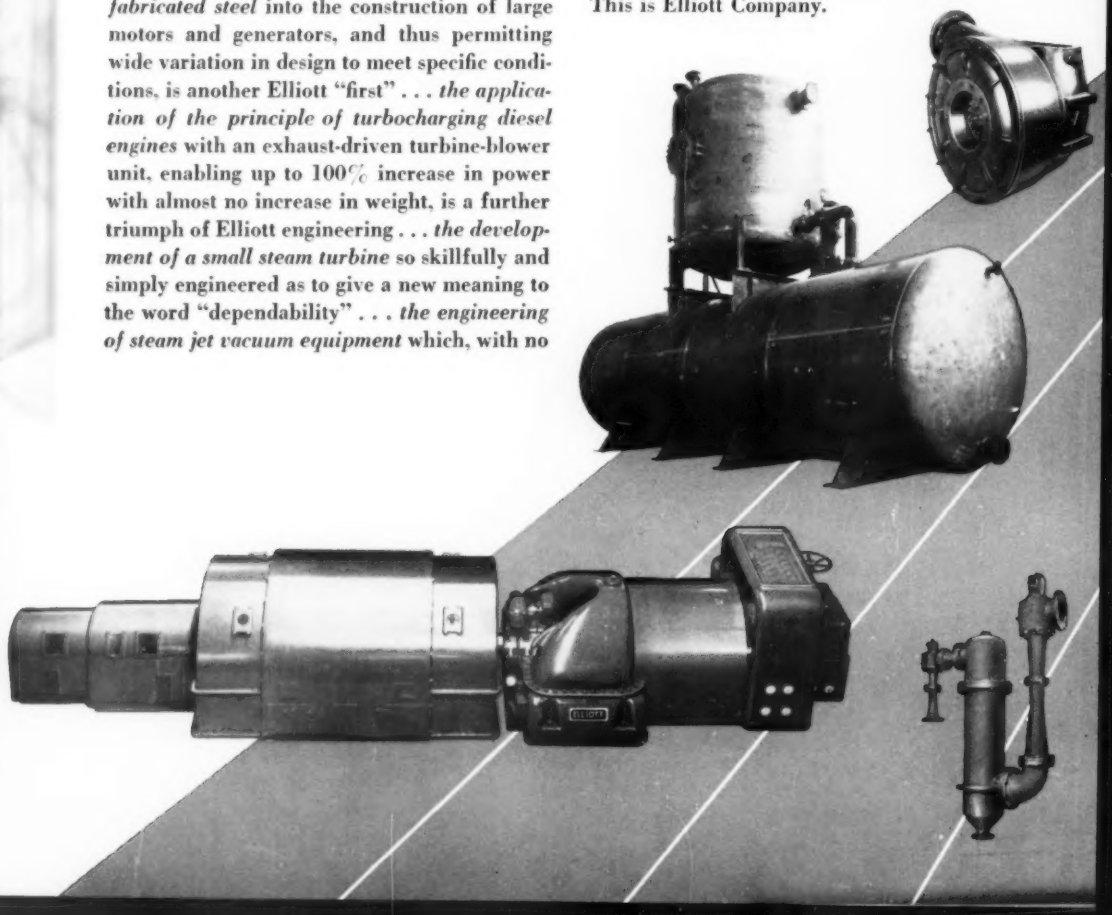
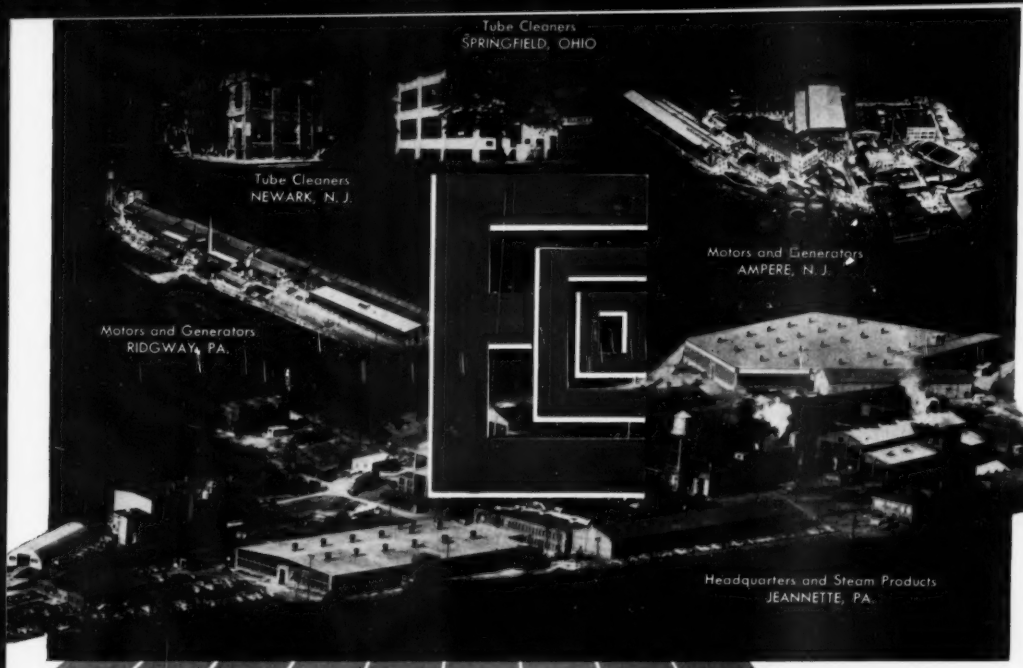
This is ELLIOTT COMPANY

Sparkplug of progress in power generation and the process industries!

WINNING THE WAR WITH CORROSION in steam power systems, was the direct result of Elliott engineers' work in *deaeration* — the removal of rust-causing oxygen from boiler feedwater. Today, Elliott deaerating heaters are protecting power plants everywhere . . . *introducing the crack-proof strength and rigidity of fabricated steel* into the construction of large motors and generators, and thus permitting wide variation in design to meet specific conditions, is another Elliott "first" . . . *the application of the principle of turbocharging diesel engines* with an exhaust-driven turbine-blower unit, enabling up to 100% increase in power with almost no increase in weight, is a further triumph of Elliott engineering . . . *the development of a small steam turbine* so skillfully and simply engineered as to give a new meaning to the word "dependability" . . . *the engineering of steam jet vacuum equipment* which, with no moving parts, produces a new low in commercial absolute pressures . . . all these and more are the contribution of a single organization to America's industrial progress, the combined plants of which total 27 acres of modernly equipped productive area, backed by a nation-wide engineering and service organization. This is Elliott Company.





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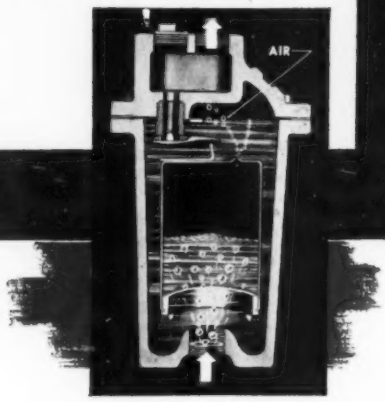
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

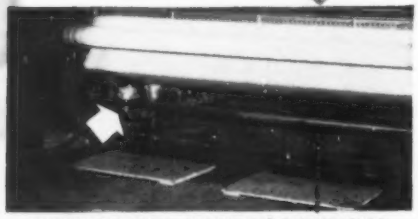
Armstrong traps vent air to give you hotter machines

HIGHER TEMPERATURES MEAN MORE OUTPUT



PSIG	Temp. of Steam with No Air Present	Temperature of Steam Mixed with Various Amounts of Air. (Per Cent Air by Volume)		
		10%	20%	30%
10.3	240.1	234.3	228.0	220.9
25.3	267.3	261.0	254.1	246.4
50.3	298.0	291.0	283.5	275.1
75.3	320.3	312.9	304.8	295.9
100.3	338.1	330.3	321.8	312.4

THIS TABLE TELLS THE STORY. *You can't get the maximum temperature you need unless you get the air out.*



PYROMETER TESTS SHOWS 30° TEMPERATURE INCREASE on flatwork ironer rolls at *Peter Bent Brigham Hospital, Boston,* after installation of Armstrong traps which vent air along with condensate.

EVERY time an Armstrong steam trap opens there is a momentary pressure drop which "pumps" air down to the trap from the unit being drained. The air passes through the bucket vent and accumulates at the top of the trap to be discharged along with condensate each time the valve opens.

This one basic benefit of the Armstrong trap is saving industry thousands upon thousands of dollars through faster heat-up and higher, more uniform temperatures with resultant greater output and time and labor savings.

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Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

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May, 1952

VOLUME 56 — NUMBER 5

CONTENTS

L. D. C. Gas Turbine Runs on Coal 56

By John I. Yellott and Peter R. Broadley

Here is the latest report on the coal-fired gas turbine now on test at Dunkirk, N. Y. The full-scale turbine, with all its coal preparation equipment and accessories just as it will go into an actual locomotive, was operated for 178 hours last fall, burning pulverized coal, then opened for inspection, and the turbine rotor and stationary blades were found entirely clean, except for one very small spot of erosion on one blade. The turbine has been reassembled, is again running on coal in 750-hour test.

First Marshall-Plan Power Plant for Italy 59

How to Size Piping and Valves for Flashing Mixtures 60

By W. F. Allen, Jr.

Handling flashing mixtures of water and steam is a really practical problem in blowdown lines, extraction heater circuits and so on in the power plant, because the flashing will not only prevent proper flow but also will cause erosion of valves and some times of piping. Methods of figuring correct sizes, with comparisons of calculated and test data, are shown.

POWER ENGINEERING News Reel 62

Reversible Pump Turbines Are Different 64

By Frank E. Jaski

Because of the growing interest in the reversible pump turbine and its use for pumped storage, you will want to read here how the pump turbine must be built, designed and model-tested in a different way from the conventional hydraulic turbine.

Your Electrical Distribution System—Asset or Liability? 66

By Paul C. Ziemke

To find out which it is, you've got to make a real engineering survey, not merely a cursory inspection. This article tells you what you will have to look for in checking voltages, insulation, power factor, circuit capacities and other items. A subsequent article will tell you exactly what instruments you will need and just what to do with them.

New Slants on Smoke 69

By Paul A. Dobbs

Much has been said about smoke, its cause, prevention and cure, but the present author, power engineer for a large industrial company, has some new things to say about it. For example, he comments on relation of stack diameter to smoke density, use of excess air to prevent smoke, merit awards for nonsmoking stacks.

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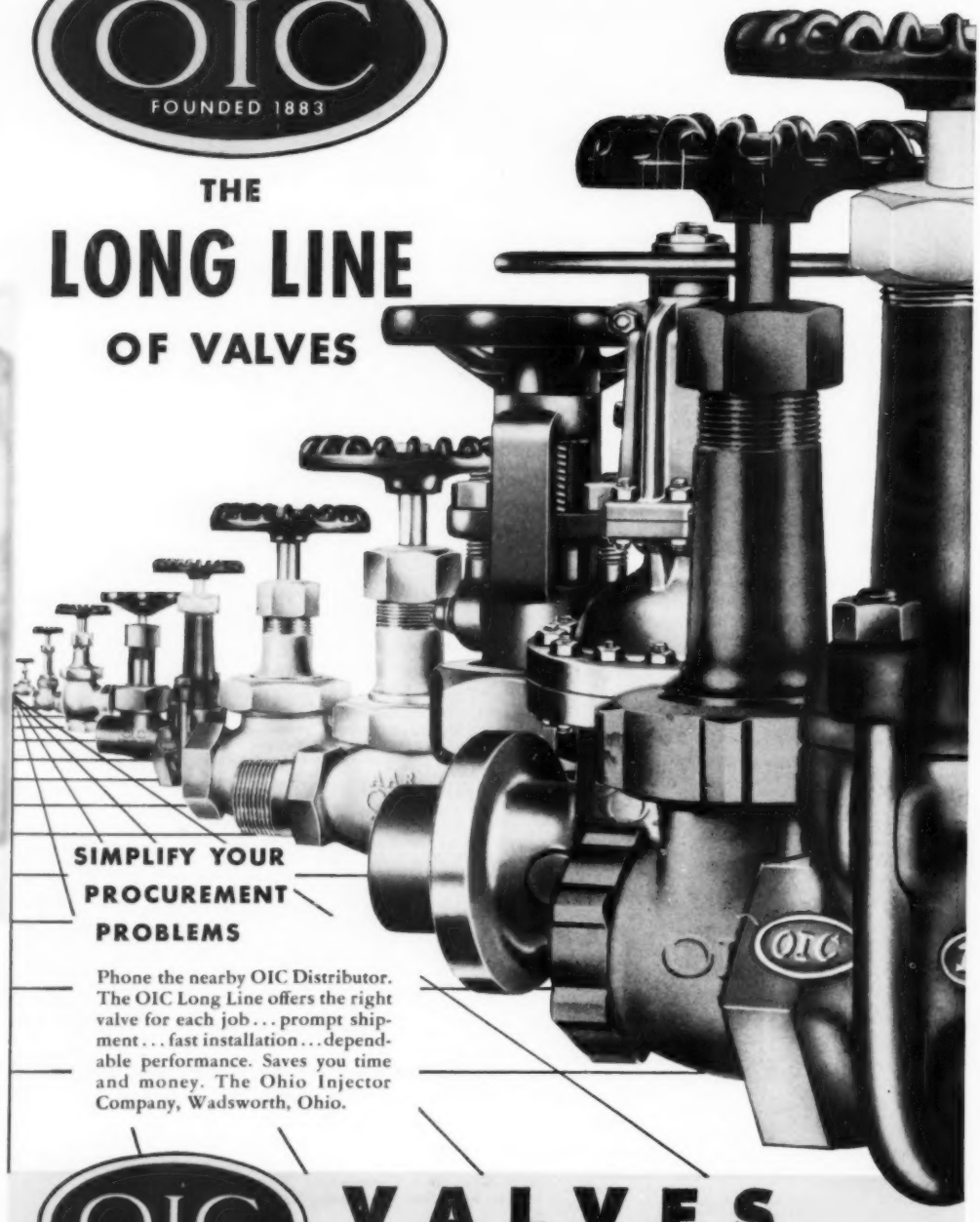

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ENGINEERS' PREVIEW

WHETHER this idea has been applied to coal cars, or whether it could be applied, we don't know. But the Atlas Car and Mfg. Company now installs a lacework of strip heaters under the floor of its 60-ton bottom dump ore-transfer cars to keep the ore from freezing and sticking during the winter months. The strip heaters, made by GE, are clamped directly on the hopper plates in a way that allows for expansion and contraction and makes each individual heater easy to replace. Each group of heaters is connected to a fused safety switch and the heaters are enclosed in a steel cabinet with thermal insulation on the sides to prevent heat loss from the outside of the heaters, so that all of it goes to warming the hopper.

★ ★ ★

MUCH INTEREST has been aroused in the power field in recent years by the large multi-engine installations of radial internal combustion engines and direct-connected d-c generators made at aluminum plants, such as those of Aluminum Company of American and Kaiser Aluminum and Chemical Corp. A similar installation of 80 of these engines is planned for the new Reynolds Metals Co. aluminum plant in the South.

The most surprising report we have heard about these installations is that at the new Kaiser plant, in addition to the two 40 engine installations, there is to be a steam plant consisting of 15 semi-outdoor steam generators and 16 turbine generators. If this report is correct, it will be interesting to learn, if possible, the relative cost of the two types of installation, number of operating engineers required, and the underlying reasons for such a multiplicity of generating units for this single plant.

Referring to the Aluminum Company power plants noted above, we learn that 74 new Nordberg radial gas engines are being installed to supply electricity for new potlines being built at the Point Comfort Plant of Aluminum Company of America. These will be in addition to the 120 engines that make up the original power plant. The new engines will be similar to those already operating, except that they will have 12 cylinders instead of 11 and will have about 9 per cent greater output per engine. The Point Comfort works was the first to adopt the radial gas engine for generating power and making aluminum.

Two new aluminum smelting plants are also under construction by Alcoa. One of these, using hydro power is being built at Wenatchee, Wash.; the other, to employ a lignite-burning steam power plant, is now under construction at Rockdale, Texas.

★ ★ ★

IF YOU HAVEN'T already seen it, don't miss it when it comes around in your region. "It" is the Silicone Show, officially the Dow Corning Silicone Exposition, now touring the country and scheduled for the important cities. You've probably seen isolated examples of different silicone products before, but this shows them to you all in one exhibit, and the effect is impressive. Especially for the power man, the various forms of silicone insulations, silicone rubber sealing devices and silicone oils and greases, all demonstrated in action at temperatures ranging from −100 F to +350 or 400 F, is worth seeing.

There are details of all types of relaying and switching equipment, motor construction, uses of the material in air compressing and refrigeration. One extremely interesting and spectacular device shows how a ring of silicone stops a liquid from foaming as it issues from the end of a tube. (This is not boiler foaming, by the way.) Most spectacular part of the exhibit, however, is that showing a small motor insulated with silicone running continuously and in spite of repeated dunkings in water about 8 times a minute, the heat of the motor windings being sufficient to raise the water to boiling temperature.

★ ★ ★

SCHOLARSHIP fund at Illinois Institute of Technology through an outright gift to the Institute, has been established by Delta-Star Electric Co., Division of H. K. Porter Co., Inc. It will be awarded to qualified applicants suggested by the Scholarship Committee of the Institute and it is intended that each scholarship will cover the yearly tuition for the four-year course.

Fig. A. This section of the Silicone exposition demonstrates silicones designed to have excellent dielectric properties at temperatures from −70 to + 500 F. Exhibits intended to show that size and weight of electrical equipment can be reduced by as much as 50 per cent through use of Silicone electrical insulating materials

Fig. B. "Dunking motor" in Silicone exposition, designed to demonstrate resistance of silicone electrical insulation to heat and moisture. This special motor with silicone insulation is built to run so hot that it boils the water as it runs alternately in air and water, with one end bell removed

NEW PATENT ABSTRACT service has been inaugurated to supply photographic copies of patent abstracts weekly, as issued in the Official Patent Gazette. The subscriber gets only the class and sub-class or type of patents in which he is interested. Abstracts are reproduced full size on 4 by 6 cards, punched for instant sorting. For complete information, contact Picturesort Co., 246 Church St., New Haven 10, Conn.

★ ★ ★

THE STEEL COMPANIES, engaged in their greatest programs of expansion and improvement, have raised capacity of the world's largest steel industry more than 17,300,000 tons in five years. That increase almost equals the total annual capacity of Great Britain and is about one-half the estimated total capacity of Russia, the second largest steelmaking nation. Total annual steel capacity of the United States is now 108,587,670 tons.

★ ★ ★

ENGINEERING FOUNDATION'S Annual Report for 1950–1951 has just been issued and may be secured from the Foundation at the Engineering Societies Building, 29 West 39th Street, New York 18, N. Y. The report contains, after some forewords, reports and the financial statement for the year, progress reports of current projects. These include projects on structural joints, reinforce concrete, wave research, properties of various metals, lubrication, effect of temperature on properties of metals and welding research. The book also contains a list of publications of the Foundation.

★ ★ ★

DR. GEROLD SCHWARZENBACH, Swiss scientist, has been granted U. S. patents Nos. 2583890 and 2583891, covering the new water-hardness tests that have gained widespread use in the past two years in this country. These were reported in detail in two articles in POWER ENGINEERING: New Test for Total Water Hardness Eliminates False End Point, December 1949, and How New Water Test Determines Calcium and Magnesium Hardness Separately, January 1950. Dr. Schwarzenbach is professor of chemistry at the University of Zurich and was associated with the Chemische Fabrik Uetikon in Switzerland in this development. His method for total hardness determination has proved rapid, simple and accurate within 1 ppm, compared with the ancient "soap-shaking" method, which is cumbersome and involves considerable judgment. Both total hardness and hardness due to calcium alone can be quickly and precisely determined by the new tests and magnesium can be found by difference. The end point of these tests is sharp and readily detected.

★ ★ ★

MICA industry in the United States may be freed from dependence on foreign sources by a development that permits utilization of domestic sources of mica for a variety of electric insulating applications, says Robert L. Gibson, general manager of GE's Chemical Division. Key to the development is a special process by which minute mica flakes are so treated that a force is generated which holds the tiny particles together. Resulting product is in the form of a continuous sheet, produced in thicknesses ranging from 0.002 to 0.006 in. that has better dielectric strength than present machine and hand-laid mica products. Referred to as G-E micamat, the new product is at present being pilot-planted in the laboratory of GE's Transformer and Allied Products Division.

★ ★ ★

CALIFORNIA OIL reserves are considered inadequate to supply steadily mounting Pacific Coast demands which already have outstripped present production in the California oil fields, and are due to be supplemented with oil from the gushing wells of Alberta, Canada.

The black gold of the western Canadian prairies, at present locked behind the Rockies, will be brought through passes in the mountains by a 700-mile pipeline from Edmonton to Vancouver, British Columbia, to be completed by the end of 1953. Construction of the 24-inch pipeline is scheduled to start sometime in the early part of this year. It will be built by Trans Mountain Oil Pipe Line Co.

This was disclosed at the spring meeting of The ASME in the University of Washington, by D. L. Roberts, vice president, Canadian Bechtel, Ltd., Vancouver. He said oil discoveries in the Province of Alberta have continued steadily.

★ ★ ★

NEW fail-safe ship steering servo mechanism, employing magnetic amplifiers instead of vacuum tubes has been developed to permit tracking of steering wheel and rudder to an accuracy of one quarter of one degree.

★ ★ ★

RECOGNIZING as its first responsibility to American business the job of teaching operating management the economics, administration and technology of up-to-date material handling, The Material Handling Institute, Inc., has launched an Industry Service Plan, which will use the press, the platform and the conference table to go into the field and work with industrial leaders "on location." Directing the new Plan is George R. Brockway, Vice President, the Rapids-Standard Co., Inc., Grand Rapids, Mich., and a committee consisting of six authorities from equipment manufacturing firms in the materials handling field. Full details from Mr. Brockway.

★ ★ ★

SEAMLESS stainless steel tubing was produced on new hot extrusion facilities of Tubular Products Div. of B & W for the first time in December. This is the first plant of its kind in the United States, designed specifically to produce stainless steel tubing by the "Ugine-Sejournet" extrusion process, to be placed in actual operation.

★ ★ ★

THREE NEW ferryboats, recently put into service at New York for the five-mile run across the bay from South Ferry to Staten Island, have set some new records for size, speed and safety. Of special interest here is the fact that they are powered by 6-cylinder, double-acting unaflow steam engines that develop 4000 hp at 170 rpm, with steam at 275 psi and 614 F. Use of this power plant was determined by several factors, as compared with the alternate possibilities of diesel electric or geared diesel engine drives. These factors included the points that: operating personnel could be used interchangeably on the new as well as on the old boats; the maintenance and repair staff of the City's Department of Marine and Aviation by which the ferries are operated, are set up for steam equipment; and the proposals indicated a higher economy for this type of engine.

★ ★ ★

IN A STEP designed to increase the operating efficiency and expand the service facilities of Burndy Engineering Co., Inc., 300 Burndy employees have just moved into the firm's recently completed 48,000-sq ft administrative headquarters building occupying a 10-acre tract off the Boston Post Rd., Norwalk, Conn.

★ ★ ★

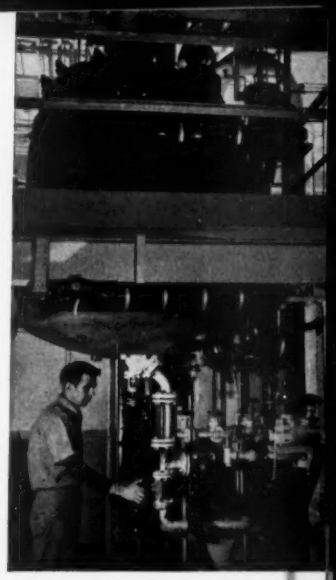
Red Face Department: — April issue, page 7; sub-caption for photograph of meeting of U. K. Specalist Team No. 17 with Chicago area engineers, contained several errors as follows: Col. 1, line 6, Republic Coal Co. should have read Republic Coal & Coke Co.; Col. 1, line 6, A. J. Doly should have read A. J. Doty; Col. 1, line 7, Union Station Steam Co. should have read Chicago Union Station Co. We are very sorry that these incorrect names got through.

Continued on page 106

Chas. Pfizer & Co., Inc., is the discoverer and sole manufacturer of terramycin, the newest "wonder drug," which has proved effective in the treatment of *more than 50 acute infections.* Pfizer is the world's largest producer of antibiotics and a leading producer of synthetic Vitamin A.

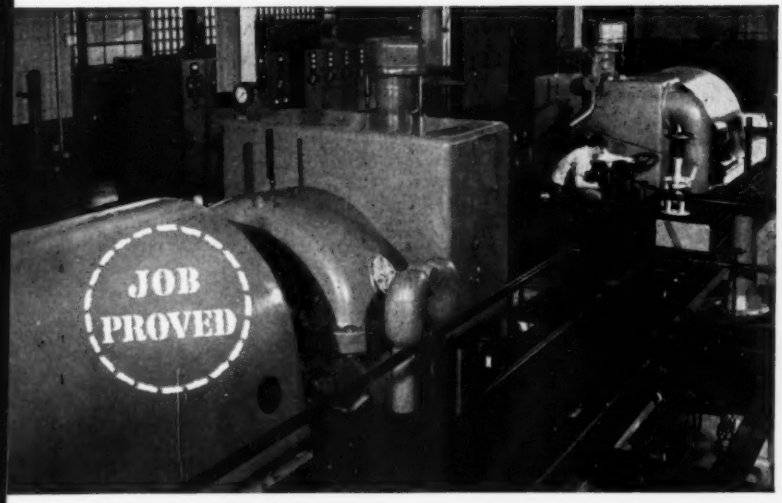
Power—lots of it and never failing—is needed by Pfizer's modern plant at Groton, Conn., to safeguard round-the-clock production. The plant relies entirely upon its two steam turbines for power, light, and refrigeration. For the utmost protection, "Job Proved" Sunvis 916 Oil was chosen as the lubricant for these turbines when installed—two years ago. This Sunvis 916 has been in continuous service ever since. As expected, inspections show the turbines free from rust, sludge, and corrosion; and laboratory tests show the oil ready for thousands of hours of continued service.

Sunvis 900 Series Oils are unsurpassed as turbine lubricants. Under normal operating conditions they will be *good for the life of your turbines.* For complete information, telephone the Sun Office nearest to you or write Department **P-6.**



THE EQUIPMENT pictured here is utilized in one of the stages of a complex process that Chas. Pfizer & Co., Inc., world's largest producer of antibiotics, follows in the manufacture of its new "wonder drug," terramycin.

POWER FOR "WONDER DRUG" PRODUCTION PROTECTED BY SUNVIS TURBINE OIL



TWO 2,500 KW TURBINES, each charged with 300 gallons of Sunvis 916 Oil, generate all of the plant's power. The condensing-extraction unit has been running over 15,000 hours, the back-pressure unit over 7,000 hours.

THE LUBRICATING OIL flows continuously through a layer of wool, then a tank of water, and finally a triple bag filter. Recent tests at Sun's laboratories show that the oil is in excellent condition, and good for thousands of hours more.

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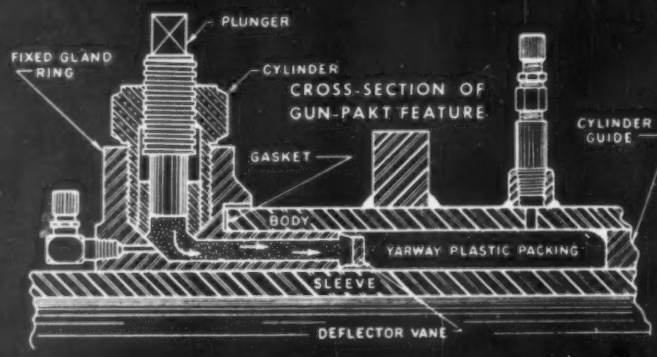
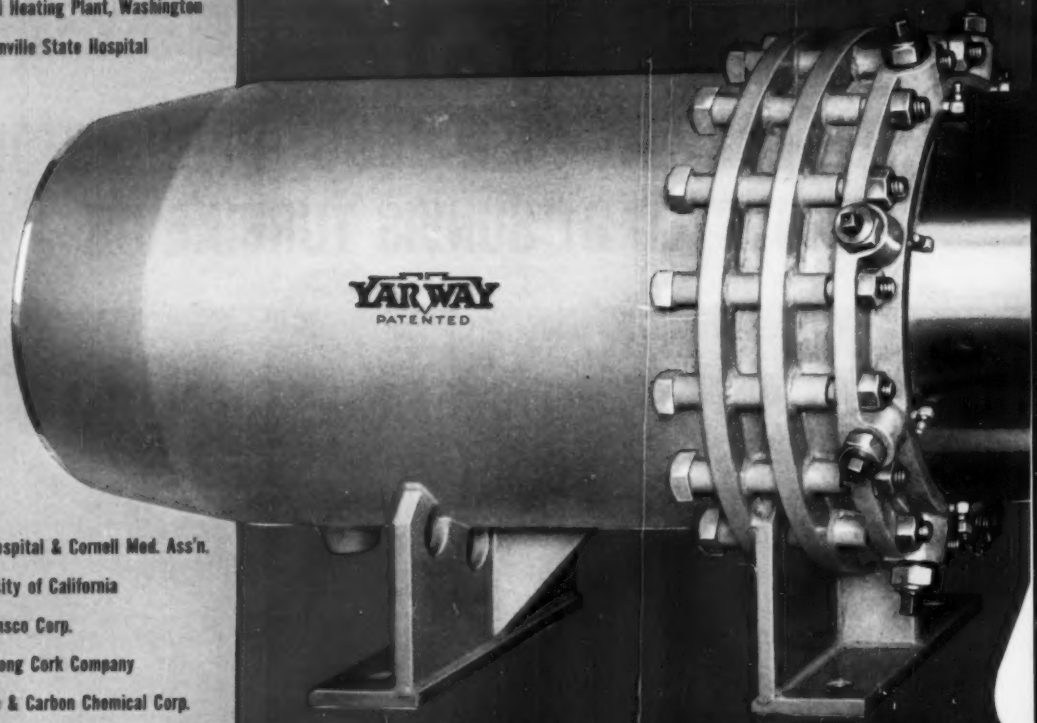
Public Service Company of Colorado

this expansion joint





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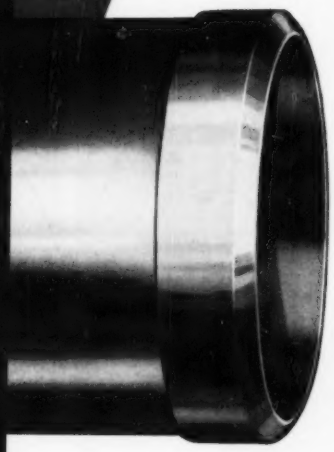
What feature do you want most in an expansion joint . . . sure movement, simplified installation, ease of servicing, low cost, low upkeep?

Yes, they're all important. But when you're dealing with steam under pressure, *there's nothing more important than reliability—freedom from shutdowns.*

The high factor of safety in Yarway Gun-Pakt Expansion Joints prevents shutdown losses—eliminates accident hazards.

Gun-Pakt Joints are *rugged* joints, strong and dependable. They are *serviced under full steam pressure.* Packing is added simply by inserting a plug of Yarway plastic packing and turning a wrench . . . the joint's tight, the job done.



Yarway Single-end Gun-Pakt Expansion Joint, welding type. Double-end and flanged types also available.

FEWER JOINTS NEEDED

With Yarway Gun-Pakt Joints you need fewer joints per length of pipe line. Each sliding sleeve may have a traverse of either 4″, 8″ or 12″ . . . maximum expansion being 24″ for a double-end joint.

Gun-Pakt is more than just another expansion joint—it is a revolutionary idea in expansion joint engineering. Its success is shown by wide use in leading central heating stations, institutions and industrial plants.

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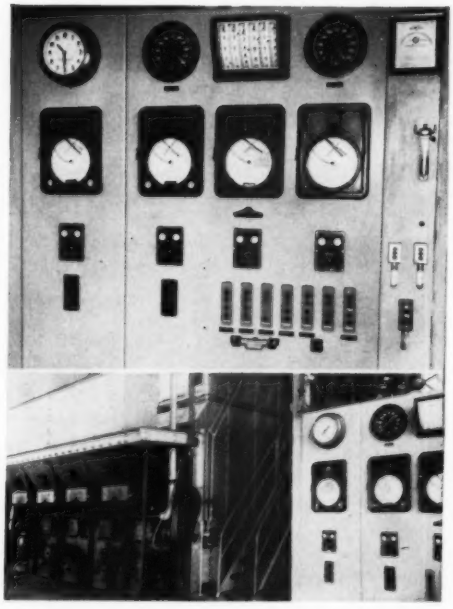
Bailey Meters and Controls Insure Savings at Kerr Bleaching & Finishing Works, Concord, N. C.

The key to complete returns on any investment in new power equipment is a fully co-ordinated system of meters and controls. It's the old story, the tail that wags the dog—careful attention to this comparatively minor part of the over-all installation cost can mean the difference between profit and loss in operation.

Here's where Kerr Bleaching & Finishing Works has cut operating costs—by installing *co-ordinated* Bailey Meters and Controls. The installation includes Bailey Meter Combustion Control, and Bailey Two-element Feed Water Control.

Such a co-ordinated system is an important plus for Bailey customers. Nowhere else can you buy such a complete range of equipment, selected without bias to do the best job for you. Nowhere else can you find such expert engineering service, immediately available through conveniently located direct sales and service representation. May we help you?

Call our local branch office or write for Bulletin 15-H. A-113



Control panel, showing completely co-ordinated Bailey Meters and Controls at Kerr Bleaching and Finishing Works, Concord, N. C.

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BAILEY METER COMPANY

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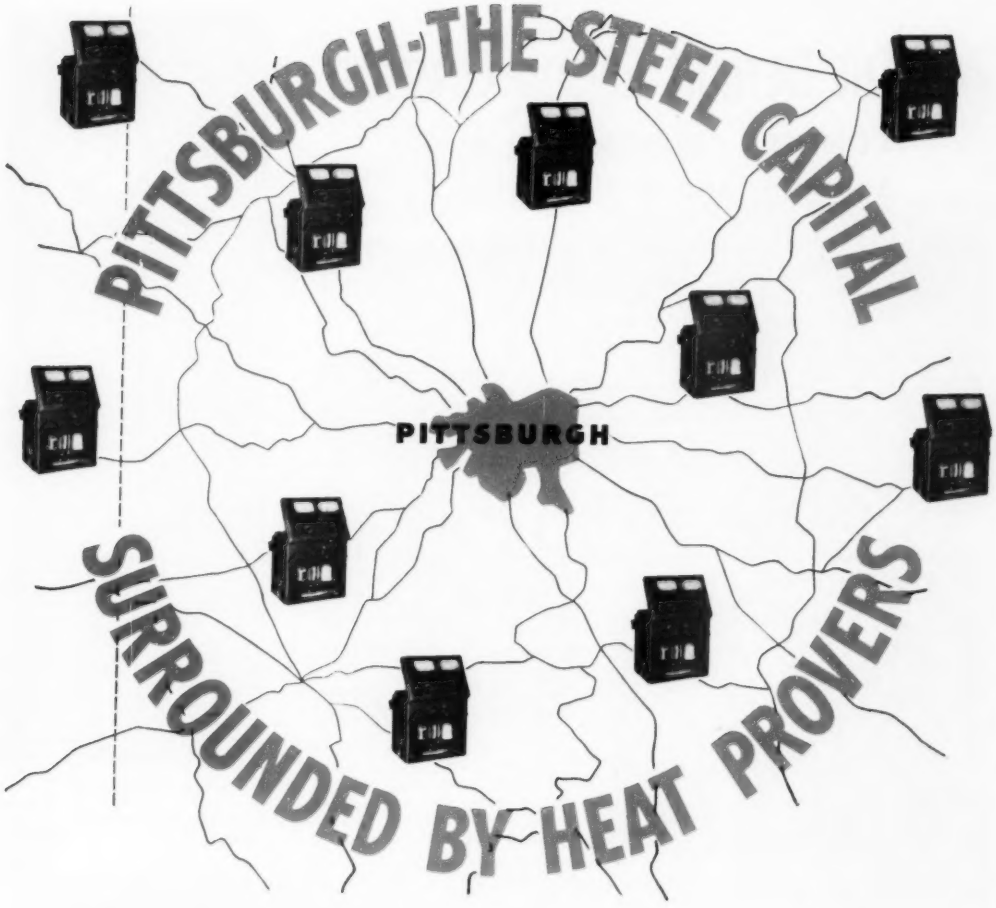
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS



When your eye is on Pittsburgh—and three dozen towns in its orbit—you're spotting scores of furnace operations regularly checked by Cities Service Heat Provers. Here, where they know all kinds of furnace instruments, and where high efficiency is most urgent today, the application of Heat Provers by Cities Service is increasingly valued.

It takes the Heat Prover to read simultaneously for oxygen and combustibles, measured direct by actual gas analysis. And the Heat Prover's continuous rapid sampling reveals effects of furnace adjustments at once. The Heat Prover frees you of maintenance too, because it's *not an instrument you buy, but a Service we supply*. Learn how it can raise productivity for you . . . in iron, steel, ceramics, glass, cement or any other furnace operation. Write CITIES SERVICE OIL COMPANY, Dept. E23, Sixty Wall Tower, New York City 5.

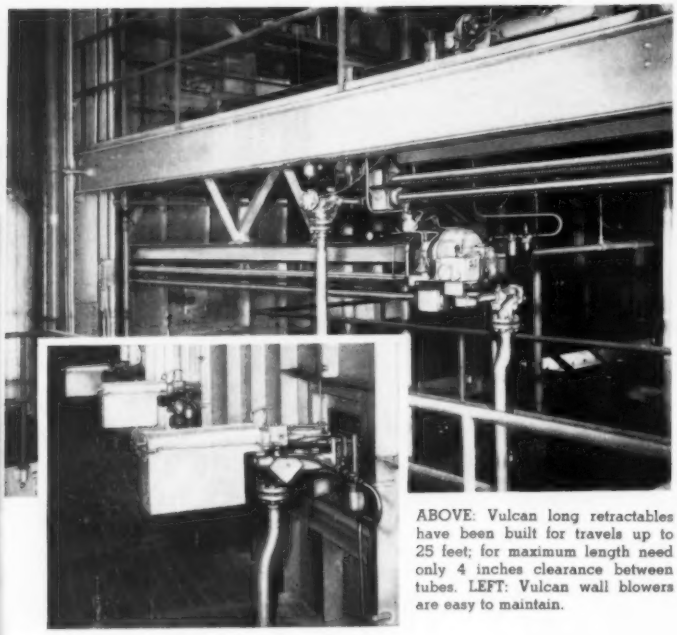
CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

at THE DETROIT EDISON COMPANY

CONNERS CREEK POWER PLANT

BOILERS 18 AND 19



ABOVE: Vulcan long retractables have been built for travels up to 25 feet; for maximum length need only 4 inches clearance between tubes. LEFT: Vulcan wall blowers are easy to maintain.

Standing at this panel, the operator can check each step of the cleaning cycle, whether on automatic or selective sequence or on manual control.

Automatically Cleaned by VULCAN

At Conners Creek Power Plant, Boilers 16 and 18 are radiant type, fired with pulverized coal. Each is rated at 660,000 pounds of 1500-psig, 950-FTT steam per hour.

Boiler cleaning is under Vulcan automatic sequential control. Each unit has wall blowers, long retracts in boiler and superheater, rotaries in economizer and controls for air-heater cleaners. All air-powered; all blow with air.

Whether your boilers are large or small—power or process—depend on Vulcan for effective, low-cost cleaning. Ask for Bulletin 483.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DUBOIS, PENNSYLVANIA

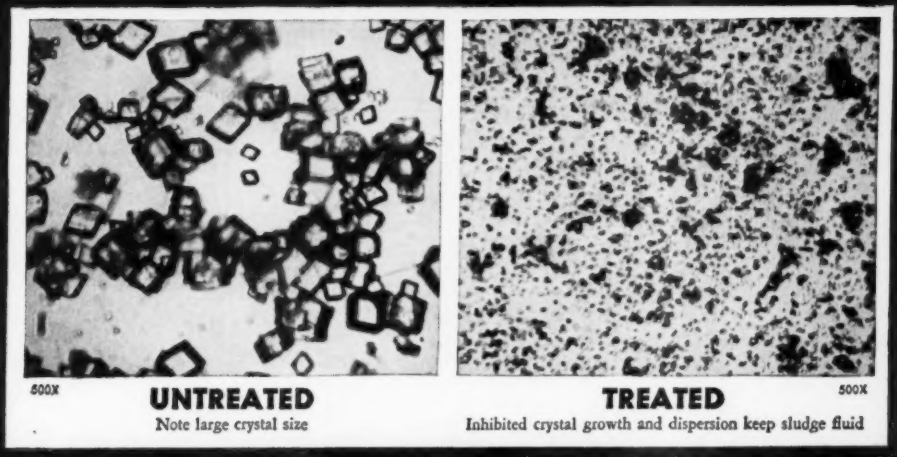
VULCAN *Automatic Soot* **BLOWERS**

ALLIS-CHALMERS

No. 26 Series

ORGANIC SLUDGE DISPERSIVE

Controls Sludge-Scale



500X **UNTREATED**
Note large crystal size

TREATED 500X
Inhibited crystal growth and dispersion keep sludge fluid

BOILER SLUDGE CAN FORM SCALE . . . because of its inherent tendency for adhering to heat transfer surfaces.

The dispersive property of Allis-Chalmers No. 26 Treatment prevents crystal growth and produces a fluid sludge, readily removed by blowdown.

To you, the engineer, this means cleaner boilers — boilers that seldom if ever require turbining or other forms of cleaning. No. 26 Treatment does not soften the water, but it can be mixed with softening chemicals (if desired) without reducing its effectiveness as a sludge conditioner. This simplifies its application and reduces your investment in feeding devices.

A COMPLETE, BRIEF discussion of the Allis-Chalmers No. 26 Series organic sludge treatment is available in our bulletin number 28X7543. (Coupon below for your convenience.)

A-3600

Allis-Chalmers
Milwaukee 1, Wis.

Gentlemen:
Please send me Bulletin 28X7543.

Name

Title

Company

Address

City State

ALLIS-CHALMERS

Water Conditioning

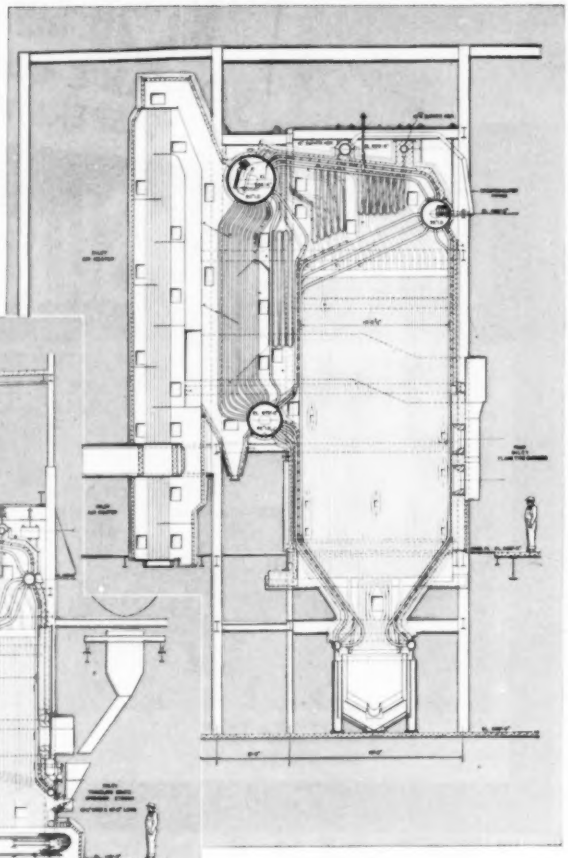
✓EQUIPMENT ✓CHEMICALS ✓SERVICE

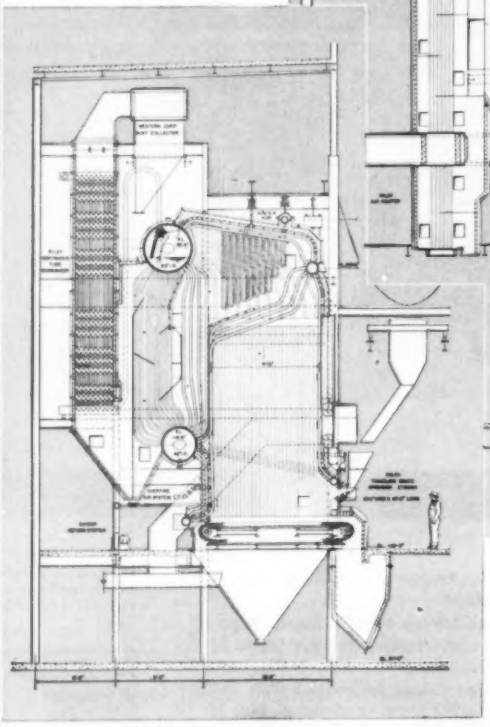
RILEY Boiler Units preferred

INTERSTATE POWER CO.
LANSING, IOWA
Sargent & Lundy, *Engineers*

2—120,000 lbs./hr. Riley Units
Steam Pressure—975 lbs.
Steam Temperature—910°F.
Pulverized Coal Fired

Interstate Power Company also has Riley Units in their plants at Clinton and Dubuque, Iowa and Shelbourne Falls, Minn.





IOWA-ILLINOIS GAS & ELECTRIC CO.
IOWA CITY, IOWA

2—60,000 lbs./hr. Riley Units
Steam Pressure—500 lbs.
Steam Temperature—740°F.

Fired by Riley Traveling Grate Spreader Stokers

TRADE MARK Rx REGISTERED

RILEY

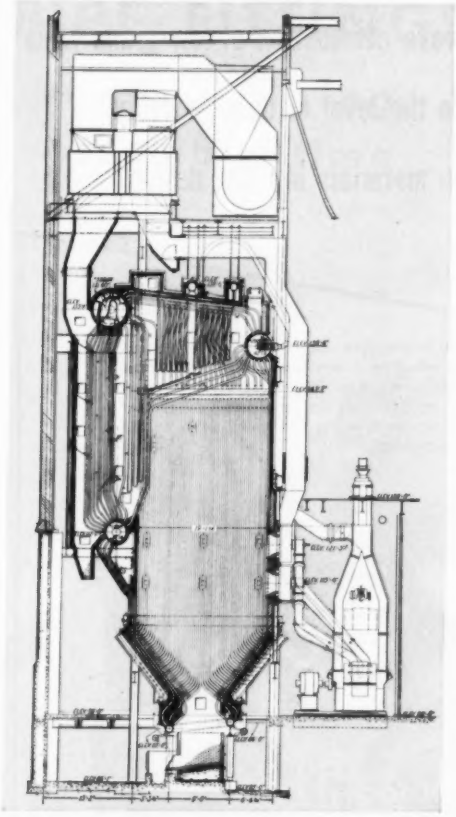
STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Charlotte · Atlanta · New Orleans · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

out where the corn grows tall

By far the big majority of recent large boiler installations in the state of Iowa have been Riley Steam Generating Units



IOWA-ILLINOIS GAS & ELECTRIC CO., DAVENPORT, IOWA

3—250,000 lbs./hr. Riley Units
Steam Pressure—1000 lbs.
Steam Temperature—850°F.
Fired by Pulverized Coal

Iowa-Illinois Gas & Electric also has Riley Units in their Moline, Ill. and Iowa City, Iowa plants.

All of these Iowa companies have Selected Riley Units in recent years

IOWA ELECTRIC LIGHT & POWER CO.
Marshalltown, Iowa
325,000 lbs./hr. 975 lbs. 910°F.

IOWA ELECTRIC LIGHT & POWER CO.
Boone, Iowa
300,000 lbs./hr. 775 lbs. 835°F.

IOWA-ILLINOIS GAS & ELECTRIC CO.
Davenport, Iowa
3—250,000 lbs./hr. 1000 lbs. 850°F.

IOWA-ILLINOIS GAS & ELECTRIC CO.
Moline, Ill.
2—200,000 lbs./hr. 925 lbs. 825°F.

IOWA-ILLINOIS GAS & ELECTRIC CO.
Iowa City, Iowa
60,000 lbs./hr. 500 lbs. 740°F.

INTERSTATE POWER CO.
Lansing, Iowa
2—120,000 lbs./hr. 975 lbs. 910°F.

INTERSTATE POWER CO.
Dubuque, Iowa
200,000 lbs./hr. 725 lbs. 910°F.

INTERSTATE POWER CO.
Shelbourne Falls, Minn.
2—120,000 lbs./hr. 700 lbs. 910°F.

INTERSTATE POWER CO.
Clinton, Iowa
45,000 lbs./hr. 450 lbs. 465°F.

IOWA PUBLIC SERVICE CO.
Carroll, Iowa
2—60,000 lbs./hr. 475 lbs. 750°F.

CORN BELT POWER CO-OP.
Humboldt, Iowa
125,000 lbs./hr. 700 lbs. 825°F.

CORN BELT POWER CO-OP.
Humboldt, Iowa
165,000 lbs./hr. 1000 lbs. 915°F.

RATH PACKING CO.
Waterloo, Iowa
125,000 lbs./hr. 450 lbs. 675°F.

IOWA STATE COLLEGE
Ames, Iowa
100,000 lbs./hr. 275 lbs. 506°F.

IOWA STATE COLLEGE
Ames, Iowa
80,000 lbs./hr. 260 lbs. 423°F.

CITY OF AMES, IOWA
95,000 lbs./hr. 700 lbs. 830°F.

The majority of the above installations are pulverized coal fired. Some are fired by Riley Traveling Grate Spreader Stokers and others by Riley Traveling Grate Stokers. We believe no other boiler company can point to such a large number of boiler sales in Iowa during the past few years.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

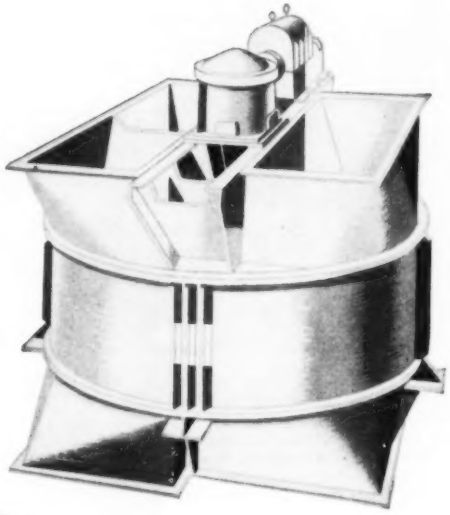
. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

The Ljungstrom Air Preheater Can Help You

1. To improve combustion of low-grade fuels
2. To raise the level of heat recovery
3. To save materials in plant design

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.



If you want to improve the combustion of low-grade fuels . . . raise the level of heat recovery . . . conserve critical materials in plant design . . . you or your consultants can make profitable use of Preheater experience. Let our specialists tell you more about the Ljungstrom Air Preheater, and the outstanding job it has done for hundreds of America's leading industries and public utilities, where the need for preheated air from 300F to approximately 1200F was part of their problem. Our engineers are ready to work with you in applying the Ljungstrom to your own heat recovery problem.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

LADISH

Controlled Quality

PIPE FITTINGS

reduce piping assembly time

Makeup goes smoother... with less chance for delay... on those piping systems where Ladish fittings are installed. Ladish Controlled Quality makes the difference. By exacting controls over materials and manufacturing processes... Controlled Quality assures uniform weldability through metallurgical integrity, fast assembly through dimensional accuracy and provides a real assurance of ultimate operating economy and complete dependability... reasons why it pays to specify LADISH.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
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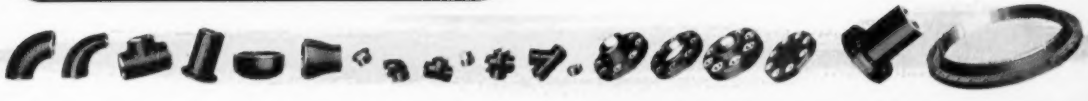


IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH **R/M**

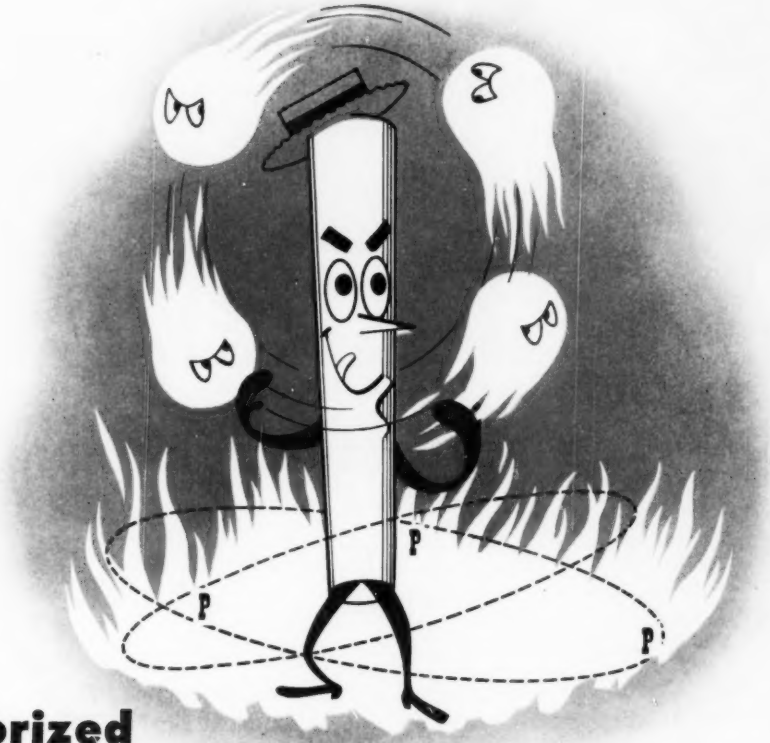
In hydraulic systems, as in this hydraulic accumulator ram, and all kinds of fluid-handling equipment, Raybestos-Manhattan Packings and Gaskets are assurance of continuous trouble-free operation. The R/M distributor near you will help you select the right R/M Packings and Gaskets for your valves, pumps, compressors, tanks and other equipment. Call him in.

R/M **PACKINGS**

RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls



Why Phosphorized Admiralty Condenser Tubes?

Required Heat Transfer Characteristics

In order to assure *uniform* chemical composition and inherent *soundness*, Scovill produces Phosphorized Admiralty tubes by its continuous billet-casting process which consistently maintains the optimum amount of phosphorus. Adding as little as 0.02% phosphorus to Admiralty also gives maximum resistance to dezincification while retaining all the other desirable properties of this alloy.

Scovill's 40-page Condenser Tube Booklet is available to users who request it on their business letterhead. Scovill Manufacturing Company, 15 Mill Street, Waterbury 20, Connecticut.

Only Scovill Phosphorized Admiralty Has All These Advantages . . .

- Uniformity and soundness resulting from Scovill continuous-casting techniques
- Relative immunity to dezincification
- High resistance to steam and condensate
- Excellent performance in fresh, salt or brackish waters
- Required heat transfer characteristics
- Superior resistance to general corrosion
- Good resistance to velocities under 7 fps

SCOVILL

A PRODUCT OF SCOVILL

SCOVILL CONDENSER TUBES

"You can't buy better brass"

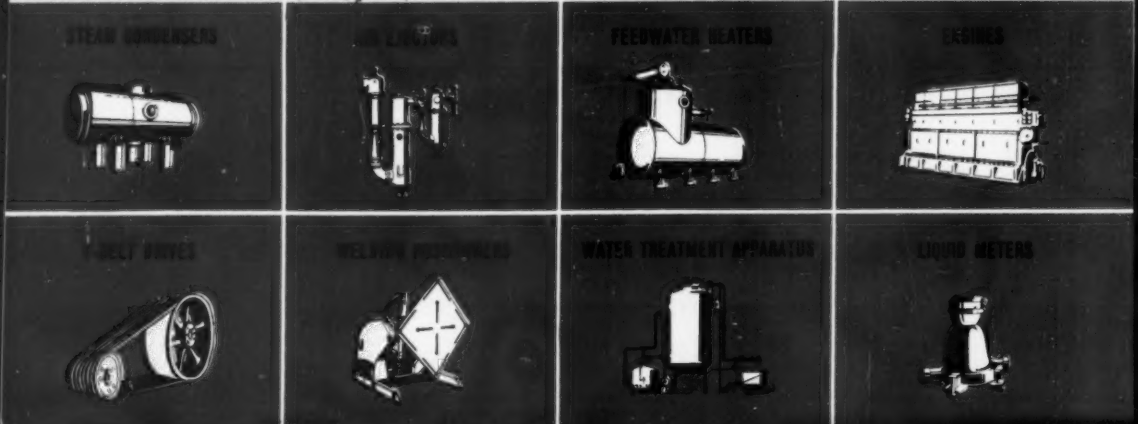
Why has the World's Leading Manufacturer of Pumps taken the "Pump" out of its name?

For 111 years "Worthington" has meant *pumps* to industry everywhere. During this period, Worthington has developed a position of leadership in many related fields. Fourteen major product lines including pumps are manufactured in 21 plants throughout the world.

To those we serve, Worthington is *more than pumps*. That's why the world's leading manufacturer of pumps has changed its name from

WORTHINGTON PUMP AND MACHINERY CORPORATION

2.2



Worthington Corporation

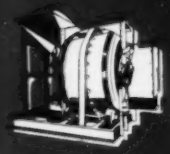
STEAM TURBINES

CONSTRUCTION EQUIPMENT

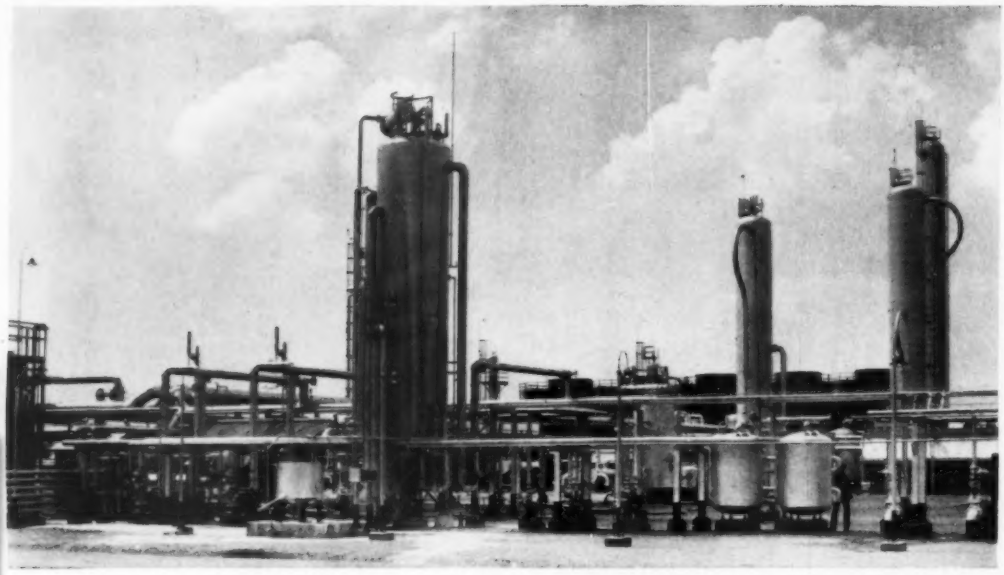
COMPRESSORS

AIR CONDITIONING AND REFRIGERATION

INDUSTRIAL MIXERS



COMPRESSED AIR EQUIPMENT



NORTH COWDEN GASOLINE PLANT near Odessa, Texas, operated by Stanolind Oil and Gas Company. Here Worthington Water Softeners protect boilers from scale-forming deposits.

Worthington softeners protect this plant's boilers 10 ways

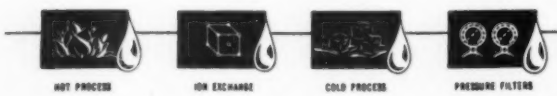
In this case, it's a hot-process softener to remove scale-forming deposits from boiler feedwater.

Let's examine this gasoline plant installation and see how it gives boilers "maximum" protection:

1. *Feed water is softened* by a hot-lime soda system.
2. *Selective deaeration* for operation on make-up only, condensate only, or both.
3. *Non-scaling direct-contact vent condenser* heats and vents treated make-up.
4. *Tubular vent condenser vents condensate.*
5. *Oxygen contamination of feedwater avoided* by last-step deaeration.
6. *Stainless steel deaerating elements.*
7. *Uniform and efficient deaeration* during wide load swings.
8. *Filter backwashing* with clean, hot, chemically inert water without velocity change through the softening zone.
9. *Proportionate sludge removal.*
10. *Uniformly proportionate chemical feed.*

Before you buy, investigate Worthington Water Softening Systems thoroughly. Tell us the service conditions, and get our recommendations in terms of dollars and benefits. Write Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Water Treating Section, Harrison, N. J.

J.1.4



Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON

Water Conditioning

STAINLESS STEEL DEAERATING TANK is hoisted in place during construction of one of Detroit Edison Company's Heating Plants at Detroit, Michigan.

When CO_2 Caused a Headache ...Worthington Cured It

Detroit Edison had the solution to its problem —the problem of CO_2 in its steam—except for one thing.

Zeolite-softened municipal water used in their steam plant contains high percentages of carbonates which decompose and generate CO_2 in the boilers. Carried over with the steam into heating and processing equipment, that CO_2 could cause plenty of trouble.

The CO_2 problem was solved by Detroit Edison engineers by acid treating the softened water, converting the carbonates to CO_2. The gas thus formed is driven off in a deaerator.

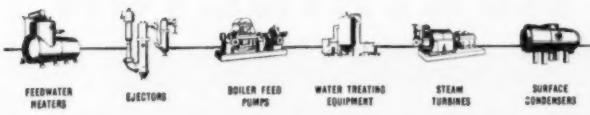
However, no standard deaerator could successfully remove the large quantities of CO_2 released by the acid treatment, and deliver water to the boiler with practically zero oxygen and zero CO_2. Furthermore, standard materials would have lasted only a few months under such conditions.

NON-CONTAMINATED STEAM

Worthington provided the answer. Detroit Edison engineers selected a Worthington deaerator specially designed for these severe conditions, built entirely of stainless steel, and guaranteed to deliver water containing not over 0.005 ppm of oxygen and not over 0.1 ppm of CO_2. The result is steam containing so little CO_2 that the amount *cannot be accurately measured!*

On problems like this one, Worthington not only furnishes *all* of the equipment needed in a complete water treating installation, but also has the engineering ability to work with your engineers on the *complete* problem of generating steam for power or processing. For further information on why *there's more worth in Worthington*, address Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

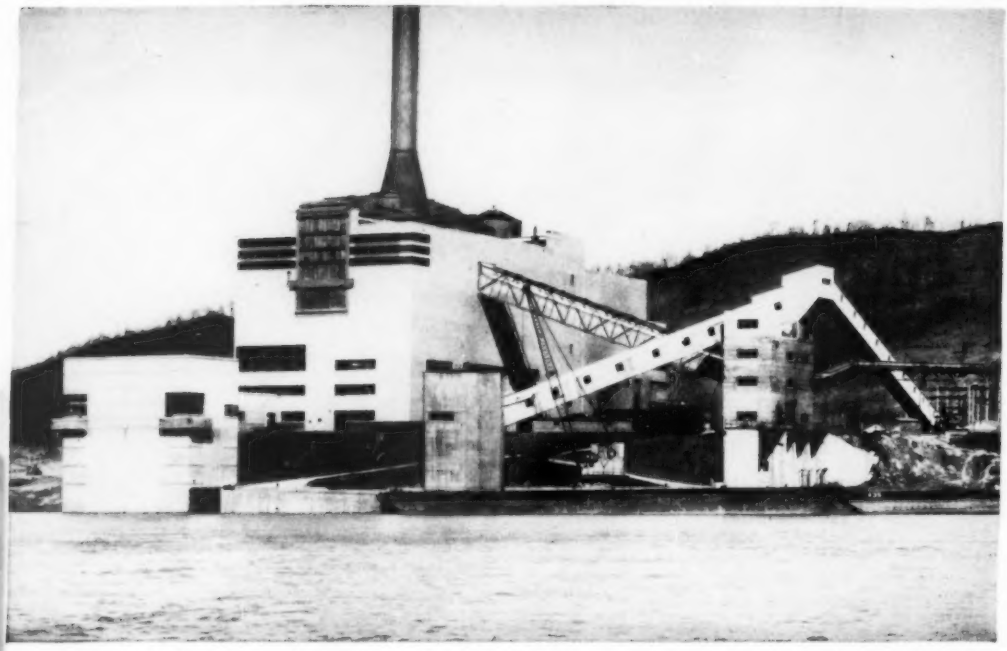
S-1-2



A GREAT TEAM IN STEAM

WORTHINGTON

Feedwater Heaters



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice or information, consult Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

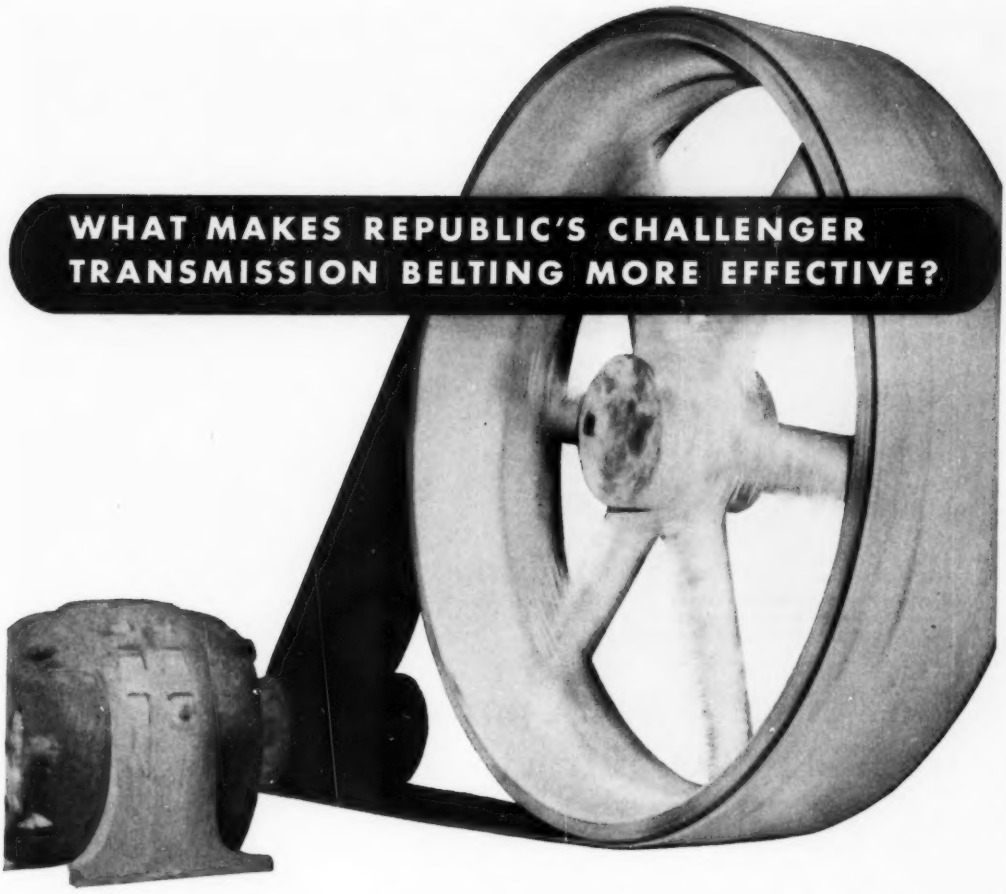
*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

Z.1.1

WORTHINGTON

WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters	Boiler Feed Pumps	Steam Turbines
Steam-Jet Ejectors	Water Treating Equipment	Surface Condensers



WHAT MAKES REPUBLIC'S CHALLENGER TRANSMISSION BELTING MORE EFFECTIVE?

Republic's Challenger Transmission Belting distributes power more efficiently because it's built of pre-stretched, hard-finished rubber-impregnated fabrics with non-slip "frictioneered" surfaces. Republic's Challenger withstands heaviest shocks and stresses, flexes easily at high speeds over the smallest pulleys.

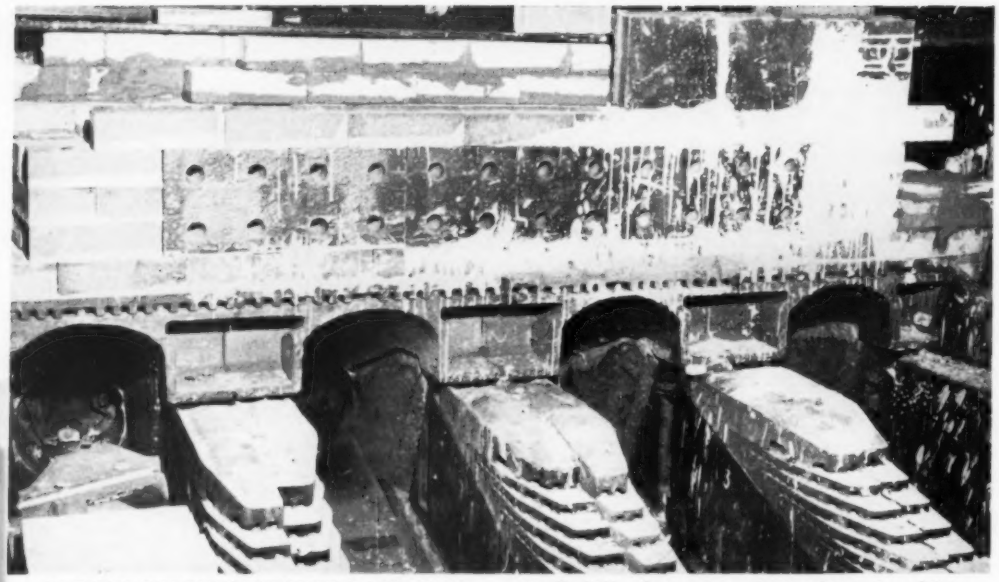
Free yourself from fastener trouble, belt slippage and premature belt failures. Ask your Republic Distributor how Challenger applies to your job requirements or write direct for full facts.

INDUSTRIAL RUBBER PRODUCTS BY

REPUBLIC RUBBER DIVISION

Lee Rubber & Tire Corporation

YOUNGSTOWN, OHIO



AIR-COOLED CRYSTOLON* REFRACTORY BLOCKS add extra life to the front wall of this boiler-furnace, fueled by multiple retort stokers. Mating tongues and grooves of these blocks simplify construction. The highly refractory, dense, abrasion-resistant nature of their CRYSTOLON refractory composition promises, years of service with minimum down-time for maintenance.

How to get EXTRA power from SPECIAL refractories

Every time you shut down a boiler to repair spalled, eroded or cracked walls, you lose power you can never get back.

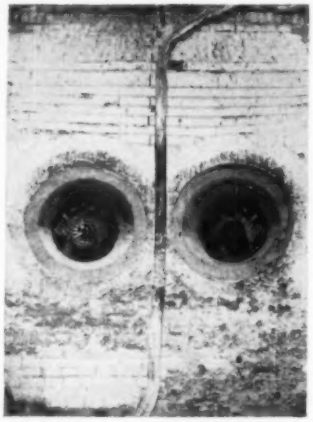
That's why it pays to keep maintenance interruptions at an absolute minimum with refractory blocks and bricks engineered to fit your exact requirements.

That's where your nearby Norton representative enters your power picture. To help you get the most power out of your boilers, he is ready to call on the research resources of Norton . . . pioneers for 40 years in the development of special refractories for complicated high-temperature applications.

Whether your power requirements call for air-cooled blocks or solid brick, you can be sure that the Norton CRYSTOLON refractories you get will give you the greatest resistance to the four common causes of boiler wall failure.

1. ***Temperatures up to 2900° F*** have little or no effect on Norton CRYSTOLON blocks and bricks.
2. ***Slag can't penetrate*** their dense structure.
3. ***Clinker adhesion is so slight*** that clinkers can be easily removed without damage to surfaces.
4. ***Abrasion of moving fire beds*** of stoker-fired furnaces has little or no effect on CRYSTOLON silicon carbide . . . itself a tough abrasive.

For more complete information about Norton CRYSTOLON refractories and the Norton Service that engineers them to your exact requirements, consult your nearby Norton representative, or write direct to Norton Company, 619 New Bond Street, Worcester 6, Mass. Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.



THESE BURNER RING PORTS for oil or powdered fuel firing of a power boiler are made of a Norton CRYSTOLON refractory cement, especially designed to resist high temperatures and abrasive action.

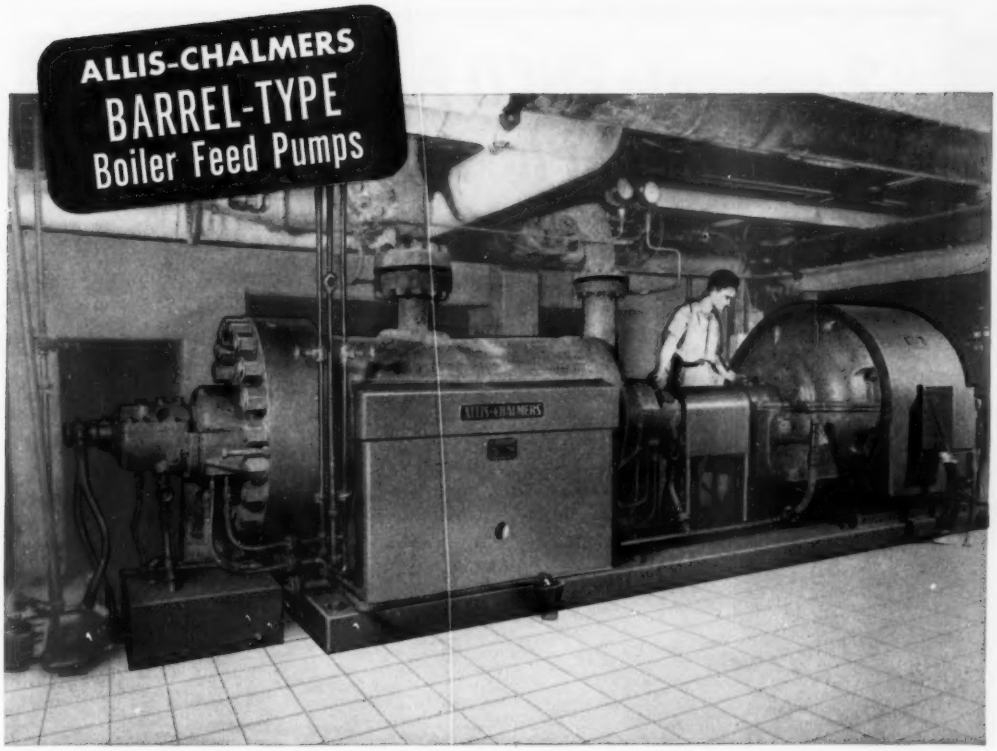
NORTON

Special REFRACTORIES

Making better products to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries



Install New Boiler Feed Pumps at South Carolina Electric and Gas

WHEN 50,000 KW CAPACITY WAS ADDED to Plant Hagood, South Carolina Electric and Gas Company, Charleston, South Carolina, this well know utility chose Allis-Chalmers barrel-type boiler feed pumps. The installations consists of two units like the one shown above. The pump is a 6x6, 11 stage rated at 485,000 lbs/hr or 1055 gpm at a total head of 4100 feet or 1630 psig. Water temperature is 300° F. The motor is an Allis-Chalmers two pole machine rated 1250 hp at 3575 rpm.

Allis-Chalmers barrel-type boiler feed pumps are proving their reliability and low cost of operation in a number of similar installations. Performance records have been such that more than 60 have been ordered for plants now being built.

Engineering Features

Proved engineering features mean you can depend on good performance and low maintenance. Single-stage back-to-back impellers balance axial forces without the use of a balancing drum. First stage has twin, half-capacity impellers to give the advantages of low NPSH. Expansion joint is on the outside of the pump. No flexible internal members are required to compensate for expansion.

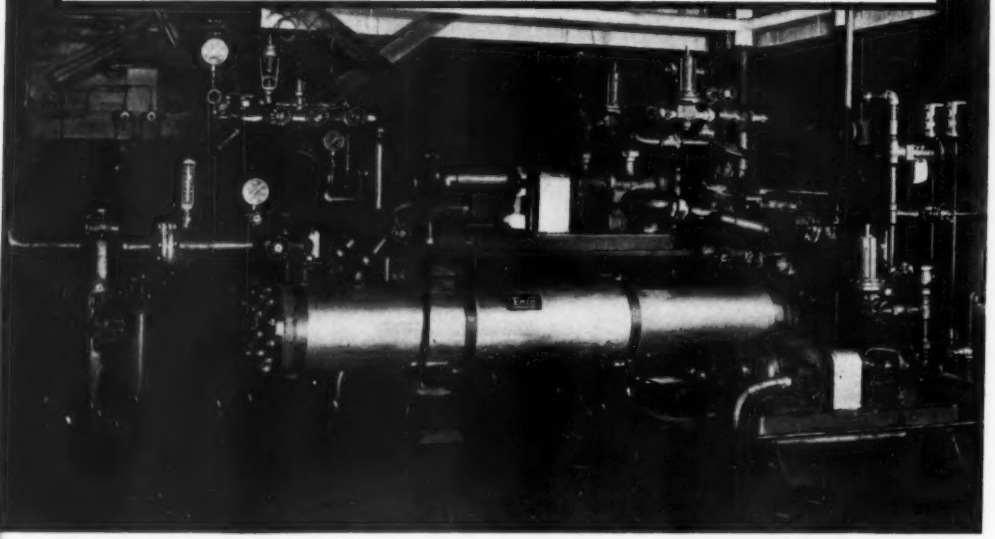
Sizes range from 1200 to 3000 psig and from 300 to 2500 gpm. Allis-Chalmers can supply the complete boiler feed pump package including pump, motor, and control of coordinated design and manufacture.

Get the details of this modern-design, performance-proved boiler feed pump from your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3672

ALLIS-CHALMERS

2 separate ENCO Fuel Oil Units Meet Plant Needs



Here is a typical Enco two-unit installation which handles fuel oil pumping and heating requirements in the plant of a building materials manufacturer.

Fuel Oil Pumping and Heating Unit, built with two pumps and two heaters, is designed for continuous plant load service. Capacity is 11 gpm Bunker C fuel oil with one pump or one heater at 300 psig pressure with a temperature rise from 90F to 230F.

Light Oil Pumping Unit for cold start-up service. Capacity is 3 gpm #2 oil at 300 psig pressure.

Enco pump sets are designed to give you easier control and longer maintenance-free operation. They are simple and economical to install. All you need do is to connect to station piping and run. Before shipping, every Enco Fuel Oil Pumping and Heating Unit is completely tested under high pressures. For complete details on wide-range line, write for Bulletin O B -37.

Only ENCO offers all ten plus features

1. Completely Automatic Operation is assured by automatic temperature and pressure regulation valves.

2. Coordinated Design Saves Space. All equipment essential to the preparation of fuel oil for combustion is contained in one compact unit.

3. Individually Designed to meet the specific needs of the particular power plant in accordance with its exact operating requirements.

4. All Parts Visible and Accessible for easy operation, maintenance and repair.

5. Pumps and Heaters are interconnected to provide maximum flexibility of operation.

6. Safety Valves protect individual parts where required.

7. Easier Maintenance — Less Service-Time for Cleaning because straight tube, multi-pass heaters with removable heads are used.

8. Pumps Operate at Moderate Speed. Heaters designed to give the correct viscosity and velocity without fouling.

9. Smoother Flow of Clean Fuel to Furnace. Air chamber for each piston pump prevents pulsations—pressure regulator for rotary pumps. Twin type strainers provided to keep atomizer tips from clogging.

10. Cleaner Boiler Room . . . all overflows connected to a common outlet, flanged drip pan catches oil drip.

EC 495

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

IN CANADA: F. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34, P. Q.

Sign of Dependability

Dependability... the kind you get from the high-tensile strength fabric and the rugged, tight-grip adhesive of U.S. Rubber's Holdtite Friction Tape. What is more, Holdtite has high-dielectric strength, is straight-tearing, non-ravelling, has no pinholes to cause troublesome leaks. Exceeds A.S.T.M. specifications.

U.S. Holdtite *Rubber* Tape is unbeatable for perfect splicing when used with U.S. Holdtite *Friction* Tape. Both exceed A.S.T.M. specifications.

QUALITY PRODUCTS OF

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SERVING THROUGH SCIENCE

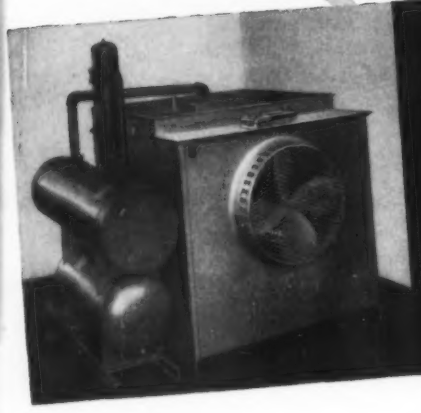
UNITED STATES RUBBER COMPANY

TAPE DEPARTMENT • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

New

SAVES WATER and CUTS MAINTENANCE COSTS . . .

Illustrations show two views of a 35 ton Condenser Tower prior to partial disassembly for shipment.



Vogt

CONDENSER TOWER

FOR CONDENSING REFRIGERANTS

SINGLE RESPONSIBILITY:

Vogt, leading builder of refrigeration condensers, assumes responsibility for engineering the unit. Only one purchase order needed.

SHOP FITTED:

To cut down field assembly labor. Requires no cutting or fitting of pipe.

Designed for today's water conservation requirements, and to keep refrigeration costs low, the *new* Vogt Condenser Tower meets the need for a proven, readily cleanable condensing unit.

The Vogt Condenser Tower consists of a multipass straight tube condenser, a receiver, an oil trap, a cooling tower, and a water pump. Removable cast iron heads permit easy cleaning of the condenser tubes.

Water costs are extremely low since the cooling water is recirculated continuously and requires only a small amount of makeup to replace losses due to windage and evaporation.

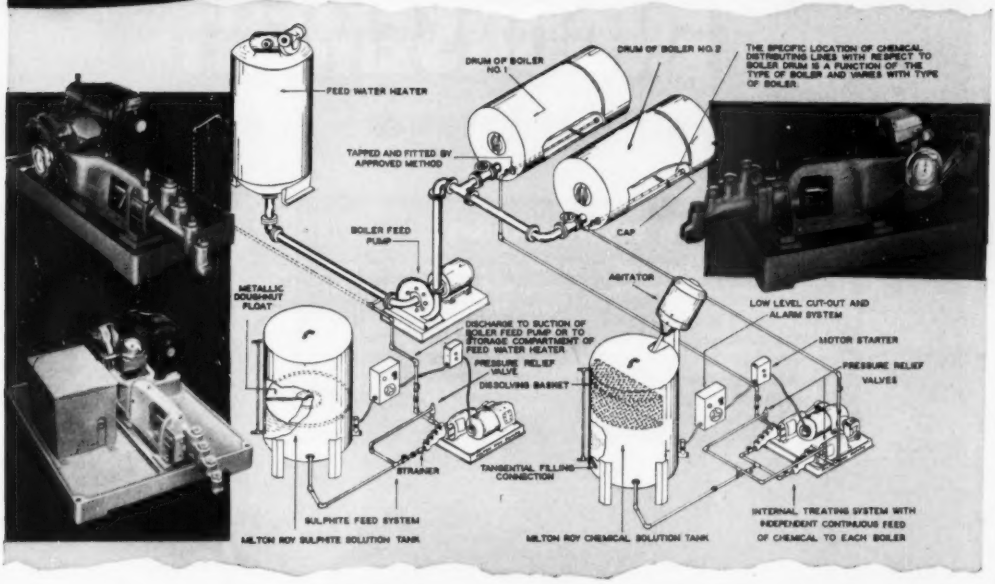
Condenser Tower units are available in capacities ranging from 5 to 50 tons refrigeration. Additional information will be furnished upon request.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

This is Controlled Volume Pumping

Continuous automatic treatment of boiler feed water, involving *precise* metering of chemicals: di-sodium phosphate directly into the boiler drum; sodium sulphite to the suction end of the boiler feed water pump; sodium hydroxide to the raw water inlet line—for pH control. Result: Boiler feed water chemically treated to prevent deposit of scale forming solids or corrosion in the system.


FEED WATER HEATER
DRUM OF BOILER NO. 1
DRUM OF BOILER NO. 2
THE SPECIFIC LOCATION OF CHEMICAL DISTRIBUTING LINES WITH RESPECT TO BOILER DRUM IS A FUNCTION OF THE TYPE OF BOILER AND VARIES WITH TYPE OF BOILER.
TAPPED AND FITTED BY APPROVED METHOD
BOILER FEED PUMP
CAP
AGITATOR
METALLIC DOUGHNUT FLOAT
LOW LEVEL CUT-OUT AND ALARM SYSTEM
MOTOR STARTER
DISCHARGE TO SUCTION OF BOILER FEED PUMP OR TO STORAGE COMPARTMENT OF FEED WATER HEATER
PRESSURE RELIEF VALVE
PRESSURE RELIEF VALVES
DISSOLVING BASKET
STRAINER
TANGENTIAL FILLING CONNECTION
SULPHITE FEED SYSTEM
MILTON ROY SULPHITE SOLUTION TANK
MILTON ROY CHEMICAL SOLUTION TANK
INTERNAL TREATING SYSTEM WITH INDEPENDENT CONTINUOUS FEED OF CHEMICAL TO EACH BOILER

THIS MILTON ROY BOILER WATER TREATMENT SYSTEM DOES THE JOB

This typical Milton Roy "packaged" system is at work in a large Eastern steam electric station. A total of ten Milton Roy Controlled Volume Pumps currently perform their precise operations in the automatic chemical feed system. As boilers are added to increase plant capacity, additional pumps are likewise added and correlated with the existing system. To precipitate calcium and prevent scaling, 12.2 gallons per hour of 3% di-sodium phosphate are pumped directly against a pressure of 2,000 psi into the boiler drum. Sodium sulphite, 3 gallons per hour in 5% concentration is pumped proportionately against a maximum pressure of 100 psi to the boiler feed water to remove oxygen. For precipitation of magnesium and for automatic pH control, a Milton Roy Controlled Volume Pump meters up to 3 gallons per hour of 5% sodium hydroxide at 100 psi, as called for by the pH control system, automatically setting the stroke length of this pump.

Proportional feed of treating chemicals to boiler feed water, utilizing automatic control devices to assure positive controlled volume metering, is typical of thousands of similar world-wide installations engineered by Milton Roy. Quantities of chemicals handled vary with the demands of the installation. Power men recognize in Milton Roy equipment the unvarying accuracy and dependability so vital a part of uninterrupted power generation.

Milton Roy supplies systems for all forms of internal and external water treatment—handling all treating chemicals—to meet all pressure and capacity requirements. Write to our engineers for complete information, or consult your classified 'phone directory for your nearest Milton Roy representative.

Manufacturing Engineers

WITH THE EXCLUSIVE STEP-VALVE DESIGN

MILTON Roy COMPANY

1320 EAST MERMAID LANE, PHILADELPHIA 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

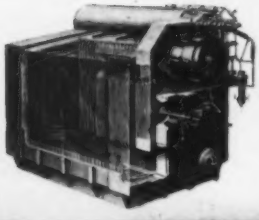
191 MILLION LB/HR ENDORSEMENT

...of B&W Integral-Furnace Boilers

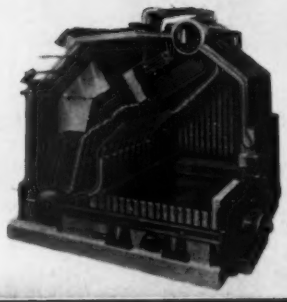
COST SAVING FEATURES

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings even with high boiler water concentrations
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

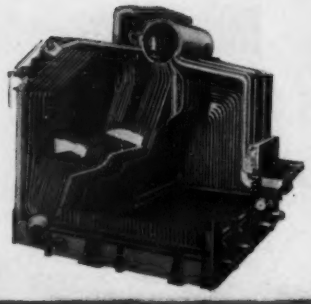
FOR STEAM



TYPE FM
2,800-28,000 lb/hr
up to 250 psi
Oil and Gas Firing



TYPE FF
8,000-50,000 lb/hr
up to 600 psi
Stoker, Oil and Gas Firing



TYPE FJ
30,000-70,000 lb/hr
up to 800 psi
Stoker, Oil and Gas

Examples of B&W Engineering For Economy

Year after year, B&W Integral-Furnace Boilers have been the leading choice of an ever wider variety of industrial and other users. This trend to B&W has been consistent . . . during the past year alone, orders for B&W Integral-Furnace Boilers amounting to almost 22,000,000 lb per hour of steam capacity have brought the total—in service and on order—to 191,000,000 lb per hour. This sweeping acceptance by users is the strongest possible endorsement of B&W dependability and economy. Today, B&W Integral-Furnace Boilers of every type and rating, covering an unusual range of steam requirements, are *service proved . . . your proof* of lower steam costs combined with higher service life when you choose B&W. And should your conditions demand a special design for the consumption of unlisted fuels, B&W can meet your requirements.

Before planning your next installation, check which B&W Integral-Furnace Boiler best covers your specific needs. Write for bulletins covering any one or all of the boilers shown. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

NOW SERVING THESE INDUSTRIES, UTILITIES AND OTHER USERS

Abrasives
Airlines
Automotive
Baking
Beverages
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Electrical
Electronics
Food
Foundry
Fruit Packing
Glass
Iron & Steel
Laundry
Leather
Lumber
Machinery
Meat Packing
Metal Working
Mining
Non-Ferrous Metals
Oil Refining
Paint
Paper
Plastics
Process
Rubber
Sugar
Textile
Tobacco

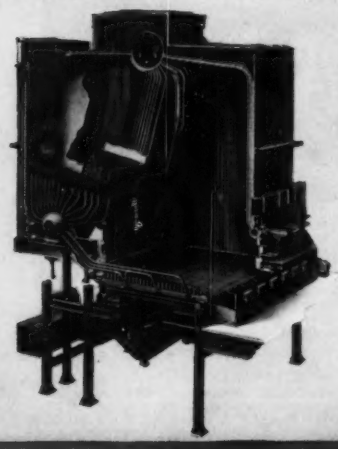
Utilities

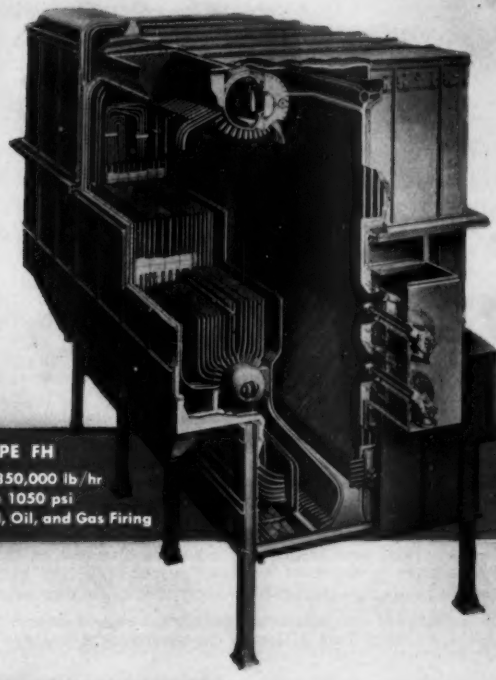
Gas Companies
Municipal Plants
Power Plants
Railroads

Others

Colleges
Florists
Hospitals
Hotels
Housing Projects
Institutions
Military Posts
Navy Yards
Office Buildings
Ordnance Plants
Stores

REQUIREMENTS FROM 2800 TO 350,000 LB/HR





TYPE FL
60,000 - 150,000 lb/hr
up to 1050 psi
Stoker, Oil and Gas Firing

TYPE FH
50,000 - 350,000 lb/hr
up to 1050 psi
Pulverized Coal, Oil, and Gas Firing

BABCOCK & WILCOX

G-5467

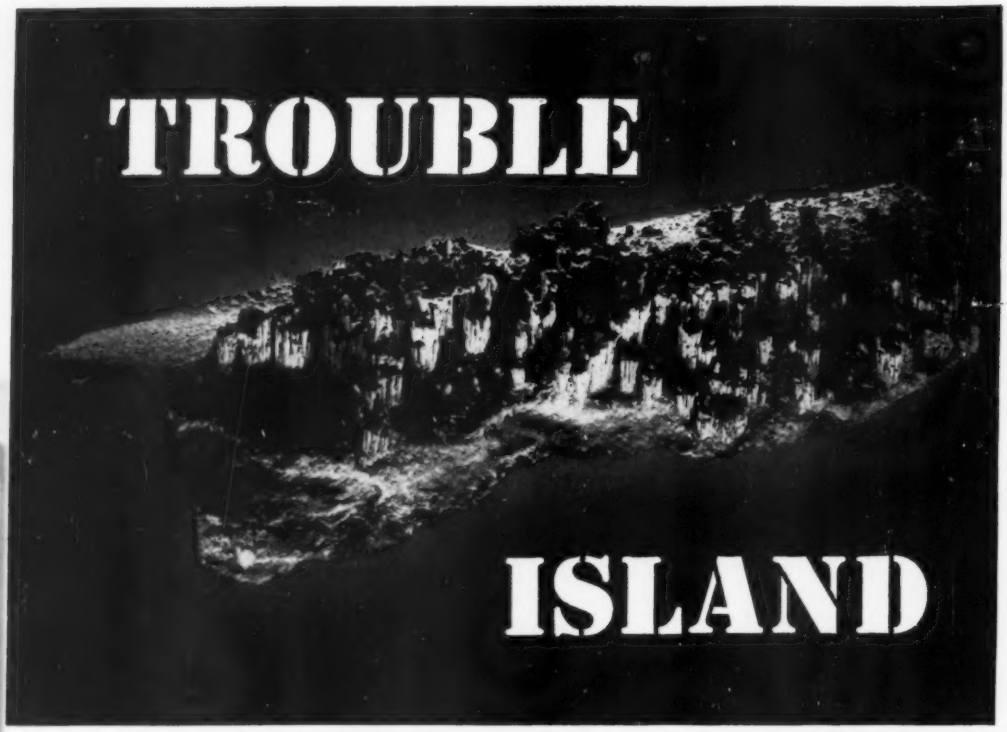


Photo is of a condenser-tube scale sample, about eight inches long. Solid scale is approximately ¼-inch thick, with "spires" ranging up to ⅜-inch height.

FIFTEEN years ago, this small island of trouble was part of a much larger open-box condenser problem at a refinery. Cooling water, running over 200°F. at outlet, contained 30 grains per gallon hardness and 20 parts per million iron. Tubes scaled heavily and rapidly without chemical inhibitor. Even with the best inhibitor then known, results were as illustrated above: partial inhibiting action creating the "spires" or forest-like deposits on tubes.

Considering this a challenge, Nalco sent a Doctor of Physical Chemistry—an expert water technologist—to the refinery. His weeks of work on the spot led to basically different treatment with new chemicals which cleaned up the condenser and kept it clean. Further Nalco research and development of chemical inhibitors has since enabled cooling systems to operate without scale or corrosion *with water hardnesses as high as 200 grains per gallon.*

Point is this: neither Nalco nor anyone else had an answer to scaling in that condenser. Nalco put the necessary brains to practical use and *got results* . . . benefiting, in the long run, not only that particular refinery, but every user of cooling water.

Whether your water treatment problem is unique, or stubborn plant-run, you will get prompt, decisive action from Nalco in the direction of positive results. Write or telephone today.

NATIONAL ALUMINATE CORPORATION
6224 W. 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to
Alchem Limited, Burlington, Ontario

THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. List the paragraph numbers of those you want on the cards on page 119, detach and mail.

INSTRUMENTS AND CONTROLS

101 Air-Operated Combustion Control — A detailed account of automatic combustion control techniques for oil- and gas-fired boilers is available in Bulletin 1023. Comprehensive illustrations and descriptions include diagrammatics showing nine typical firing methods and 16 major control equipment components. There are also individual facts and figures on 300 installations throughout the country ranging from 6000 to 1,000,000 lb-hr capacity. Bailey Meter Co.

102 Temperature Measurement for Central Stations — Instrumentation Data Sheet 9.1–12 discusses use of resistance thermometers for obtaining temperature measurements in steam generating stations. Details on the d-c Wheatstone bridge circuit, resistance thermometer bulb design and continuous balance type recorders are included. Instrumentation Data Sheet 9.1.11 covers temperature measurements with the use of thermocouples and continuous balance type potentiometers. Discusses importance of accurate temperature measurement, design details of butt-welded thermocouples, construction features of continuous balance potentiometers. Pictures basic thermocouple types and potentiometers used in steam generating stations. State choice of bulletin, or both. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

103 Controlling Pyrometers — Bulletin G-2 covers controlling pyrometers and related equipment, telling various heat controlling applications possible, and discussing functions of continuous high limit on-and-off control, or automatic shut-off and alarm. Service data and circuit diagrams and installation photos are presented. Also describes a double contact pyrometer and some of its applications which include bearing temperature. Assembly Products, Inc.

104 For Combining Control Signals — The improved design of company's Ratio Totaliser is described and pictured in color in 8-pp Bulletin 5452. This simplified, versatile mechanism is a pneumatically operated control for combining input control pressures and spring forces, and producing an output control pressure based on addition, subtraction, multiplication, division or more complicated functions of the input control signals. General and special applications are detailed. Hagan Corp.

105 Remote Pressure Recorder — Instrumentation Data Sheet 10.2–5 describes a remote pressure recorder comprising the Frederick Flader Teledyne unit plus the Brown ElectroniK recorder. Applicability, equipment requirements, and operating principles are discussed. Photos of equipment, specifications for pressure transmitters, and drawings of basic types of Teledyne transmitters are included. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

106 Combustion Indicator-Recorder — A photo-electric relay application in the form of company's Haseguage combustion indicator is described in 2-pp Bulletin 801. Since the proper ratio of air and fuel is constant concern to power engineers, this bulletin offers ready reference to fuel savings through increased combustion efficiency. Wiring diagrams of installation and relay circuits included. Ess Instrument Co.

107 Tachometer Indicators — Technical Data Sheet 42 HJK describes tachometers for high accuracy speed measurements with convenience not generally available in a continuously indicating switchboard instrument. Lists applications, outstanding features. Describes principle of operation and includes selection tables, illustrations of scales. Metron Instrument Co.

108 Flow Meters — Accurate measurement of flow in open channels is discussed in Instrumentation Data Sheet 10.3–4. Describes operation of float actuated flow meters especially applicable where Parshall flumes and weirs are used to create a fluid head. Data given covers system arrangements, principle of operation, specifications. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

109 Magnetic Converter — A new, small magnetic converter for use in converting low-level d-c error signals to a-c voltage in a wide variety of measurements systems is described in Bulletin GEC-832. Pictures the unit, discusses features, operation; includes specifications. General Electric Co.

110 Flow Meter Handbook — Newly-released Publication 10596, 40 pp, is offered to aid in the selection and sizing of variable-area meters and contains, in condensed form, the results of 15 years of research. Fully illustrated, book provides a description of variable-area meters, tubes and floats and their comparison with variable-head meters, as well as calibration prediction data. Detailed selection information is included, also explanation of how to correct changes in fluid conditions. Fischer & Porter Co.

MECHANICAL POWER TRANSMISSION

112 FHP Gear-Motors — Eight-pp bulletin GEA-5678 lists 61 standard models of fractional horsepower gear motors, describing their applications. Outlines a simple method of determining correct horsepower requirements with the use of an ordinary pipe wrench and fish scale. Contains descriptions, cutaway drawings, selection charts, and dimension tables for both concentric-shaft and right-angle shaft gearmotors, includes maintenance pointers. General Electric Co.

113 Nylon-Lined Bearings — Operating principles, design advantages and application of manufacturer's Nylined bearings for rotation and reciprocation are set forth in this bulletin. Explains how use of nylon has solved several bearing design problems. Available types discussed. Thomson Industries, Inc.

114 Reference Data on Belting — Illustrated data sheets covering manufacturer's industrial leather products and including specifications on various types of leather belting are offered to power engineers. Also provided is information on leather packings for hydraulic and pneumatic equipment. Data sheets are furnished in file folder. J. E. Rhoads & Sons.

115 Belting Manual — A practical text on leather belting, Catalog 101, 40 pp, not only lists various types and grades of belting best adapted for each drive, but also shows how to get longer life from belting through proper care, how to make a belt endless, and gives other useful information. Provides charts and tables on horsepower ratings, speeds, specifications of controlled tension bases, together with formulas that will help a power engineer figure belt requirements for new and existing installations. Also contains sizes, prices, other ordering information. Graton & Knight Co.

PUMPS

116 Centrifugal Sump Pumps — Eight-pp Bulletin WQ-220 announces improved models of company's Types VS and VN sump pumps, available in wet and dry pit types and adapted to handling clear liquids, sewage and other liquids containing solids, in capacities to 1000 gpm and pressures to 250 psi. Explains advantages of these vertical centrifugal pumps, describes and pictures construction features, includes specifications and dimensions. Warren Steam Pump Co., Inc.

117 Pump Selection Guide — Here's a new type of reference chart on small pump applications. In one convenient table it lists various types of company's pumps, services for which each is built, performance characteristics, types of packing, styles of mounting and features that distinguish each model. Tuthill Pump Co.

118 Chemical Process Pump — A pump for handling most all process liquids, hot or cold, in moderate capacities against low, medium or high heads, including corrosive and abrasive liquids with up to 5 per cent solids in suspension is described in 8-pp Bulletin B-1600. Explains and illustrates design and construction features, gives specifications of this pump, available in grease-lubricated and oil-lubricated types. Peerless Pump Div., Food Machinery and Chemical Corp.

119 For Controlled Volume Pumping — Bulletin 300, 24 pp, describes manufacturer's line of Pulsafeeder piston-diaphragm pumps, stressing their no-stuffing box feature and noting that although basically a pump, this unit can do the work of a chemical feeder, a meter, an instrument, a filling machine, a proportioner and a sampler. Also discusses special liquid-handling assemblies. Both manual and automatically-controlled types covered. Process Equipment Div. Lapp Insulator Co., Inc.

WATER CONDITIONING

120 Hot Process Water Softeners — Bulletin 2341, a 32-pp booklet, is crammed full of interesting data on the hot process treatment of boiler feedwater. A number of designs are illustrated and discussed, including conventional and sludge-blanket types, with and without built-in deaerating equipment. Also described is the new two-stage hot process lime and zeolite softener for securing boiler feedwater that is low in alkalinity and silica content and zero in hardness. The Permutit Co.

TWO POSTAGE-FREE CARDS are provided for you on page 119. List item numbers of all bulletins wanted.

121 Water Treatment Unit — Bulletin 1845, 8 pp, describes the JBAS Accelerator, a packaged water treatment unit to treat 5 to 100 gpm, for boiler feed, engine cooling, softening of process water. Explains how this equipment softens, clarifies, sterilizes or removes organic matter, tastes or odors. Infilco Inc.

122 For Highly Alkaline Water — Announcement of an alkalinity-reducing ion exchanger for use in boiler plants where raw water alkalinities are high and chlorides and sulfates are in moderate range is made in Leaflet 28X7808. Illustrates simplicity of equipment of the new exchanger and stresses its effectiveness in controlling hardness, total alkalinity and CO_2 in steam. Allis-Chalmers Mfg. Co.

LUBRICANTS, LUBRICATION

123 ABC of Molybdenum Lubrication — "Abstracts, Bibliography and Case Histories of Liqui-Moly Lubrication" (Technical Bulletin 21-G) contains a listing of current reference literature, with important articles abstracted, a list of pertinent patents, and a summary of two years of case histories of applications of molybdenum-disulfide lubricants. Also describes various forms in which Liqui-Moly lubricants are offered. The Lockrey Co.

124 Lubrication Case Histories — This new 8-pp edition of "Studies in Centralized Lubrication" presents six examples of how company's centralized lubricating systems for industrial machinery have provided worthwhile savings in time, manpower, lubricant and power used, as well as increased bearing life. The Farval Corp.

125 Moly-Sulfide at Work — Here's an interesting 40-pp booklet covering the properties and applications of molybdenum disulfide, showing not only how it is being used in a wide range of lubricating jobs, but describing the form utilized and including comments on its performance. Fully illustrated, arranged in easily-followed chart form. Climax Molybdenum Co.

ELECTRICAL

Engineers' Data Book — Book B-2161-E is a 330-pp newly-revised edition of this manufacturer's electrical data book, providing information on new equipment and new methods of use as well as an entire new section on power distribution. This comprehensive book is so designed that detailed information on almost any type of electrical equipment is readily accessible. It is divided into the three general categories of power plant, electrical distribution, and utilization and accessory equipment, with one section on engineering data which deals mainly with product application and design of distribution systems. — *To receive a copy of this book, contact company's nearest district office. Book is not available through this magazine.* Westinghouse Electric Corp.

126 Big Induction Motors — Design and application features of company's Life-Line motors (now made in ratings to 700 hp) are described in 20-pp Booklet B-4731. Applications of these motors in the paper, chemical, central station, mining, lumber and metal-working industries are illustrated. Separate sections describe the special construction of motor frames, end brackets, stators, rotors, and bearings. Standard and special mountings and enclosures are also described. Westinghouse Electric Corp.

128 Compact FHP Motors — Of special interest to users of fractional horsepower motors is 16-pp Booklet GEA-5567 covering company's new Form G line. Shows design innovations and explains increased versatility and other advantages of the new smaller motors. Full color illustrations show their streamlined appearance. Some of the several types available in the new line are pictured. General Electric Co.

SEE PAGE 119 for postage-free cards. List item numbers of bulletins wanted.

129 Vertical Induction Motors — Construction features and types of large vertical induction motors for pumps and other vertical drives are described in Bulletin 05B7629. Explains that except for bearing arrangement, the mechanical construction of vertical solid shaft induction motors is basically the same as that of horizontal units, and while customarily open, self-ventilated types, they can be provided with enclosures. Covers motor ratings in 40 C 60 cycle from 60 hp, 200 rpm, to 800 hp and larger at 1800 rpm. Allis-Chalmers Mfg. Co.

130 Compression Joints — Bulletin 67 is a 32-pp catalog covering company's compression joints for copper and aluminum cable and showing new aluminum connectors as well as copper fittings. Features company's well-known Waterseal lugs, now designed for new, small diameter cables. A handy table shows government stock numbers and equivalent catalog numbers. Several pages are devoted to hydraulic installing tools which develop pressures to 20 t and 40 t. Provides a new illustrated quick-ordering chart covering all standard connectors. The Thomas & Betts Co., Inc.

131 D-C Power Supply — Bulletin V1051 covers in detail company's Varicell, a source of variable stabilised-regulated d-c voltages operating from a-c power lines. Photos, circuit diagrams, outline dimensions, ratings and descriptive data are provided. Purpose of this voltage source is explained, illustrated with circuit diagrams. Easy operation of the equipment is discussed. The Superior Electric Co.

132 Insulation Testing Information — Now available to power engineers are articles describing recommended test procedures and practices using d-c method of insulation testing on high voltage electrical apparatus. As this method is considered a valuable tool for determining actual condition of the insulation, the articles are worthwhile reading for those concerned with operation and maintenance of high-voltage equipment. The John Hewson Co.

133 Selenium Rectifier Stacks — Booklet GET-2350, 28 pp describes basic characteristics and applications of selenium rectifier stacks. Provides charts, graphs and tables illustrating principles of rectification and characteristics, manufacture, circuit design and application of selenium rectifiers. General Electric Co.

134 "Unitized" Switchgear — Thirty-pp Booklet B-5282 opens with an explanation of what "unitized" low-voltage metal-enclosed switchgear is, and outlines the indoor and outdoor applications for which it is suited. Describes company's Types DB and DA air circuit breakers incorporated. Includes current ratings, interrupting ratings, as well as inspection, disconnection and replacement data. Standard switchgear assemblies, universal frames and bus supports are described. Also covered are bushing-type current transformers, breaker attachments, and cascading and selective tripping. Westinghouse Electric Corp.

135 Master Safety Switch — Bulletin 514 describes Vacu-Break switches, emphasising how company has reduced its line of safety switches to 37 to facilitate ordering, stocking, installation and use. Also describes principle of arc-snuffing incorporated, company's Clampmatic feature, other design advantages. Photos and drawings help explain mechanical details of the switch line. BullDog Electric Products Co.

136 Lava Insulators — Now available as "source" books are two booklets detailing technical data on properties, grades, thermal resistance of Lava insulators. Lava is a kiln-hardened natural steatite, and these insulators are produced according to individual specifications. Booklet A treats insulators for electronic tubes; Booklet B treats the insulation more generally and covers its use in a number of industries. State choice, or both. M. Kirchberger & Co., Inc.

137 Electric-Circuit Controller — Functions and applications of the Regohm direct-acting, finger-type voltage and current regulators are analyzed in Engineering Bulletin 505.00, 12 pp. Tells how this type of regulator works to provide close control of voltage, frequency and current, and how it is used in servo systems. Typical circuits shown. Electric Regulator Corp.

VALVES, PIPING ACCESSORIES

138 Automatic Valves — Eight-pp Bulletin G-3 describes features of company's Cushioned automatic water and steam valves. These are widely used industrial valves and include float, altitude, check, solenoid-operated, reducing, relief and non-return types. Operating features of each valve are explained briefly. Golden Anderson Valve Specialty Co.

139 Solenoid Pilot Valves — Technical information on company's line of solenoid pilot valves for air, vacuum, oil and water, is provided in illustrated Folder P, 8 pp. Gives sizes, operating pressure data etc. on 2-, 3- and 4-way models. Discusses special features and advantages of the line. Valvair Corp.

140 For Hazardous Atmospheres — Bulletin AVX-310 describes a new packaged, explosion-proof air valve, an electrically-controlled but air-operated unit designed to meet Group D, Class 1 Standards for wiring in hazardous locations. A modification of company's well-known standard Electroaire, design and safety features of the new model are illustrated and discussed. Dimensional drawing and wiring diagrams are included. The Bellows Co.

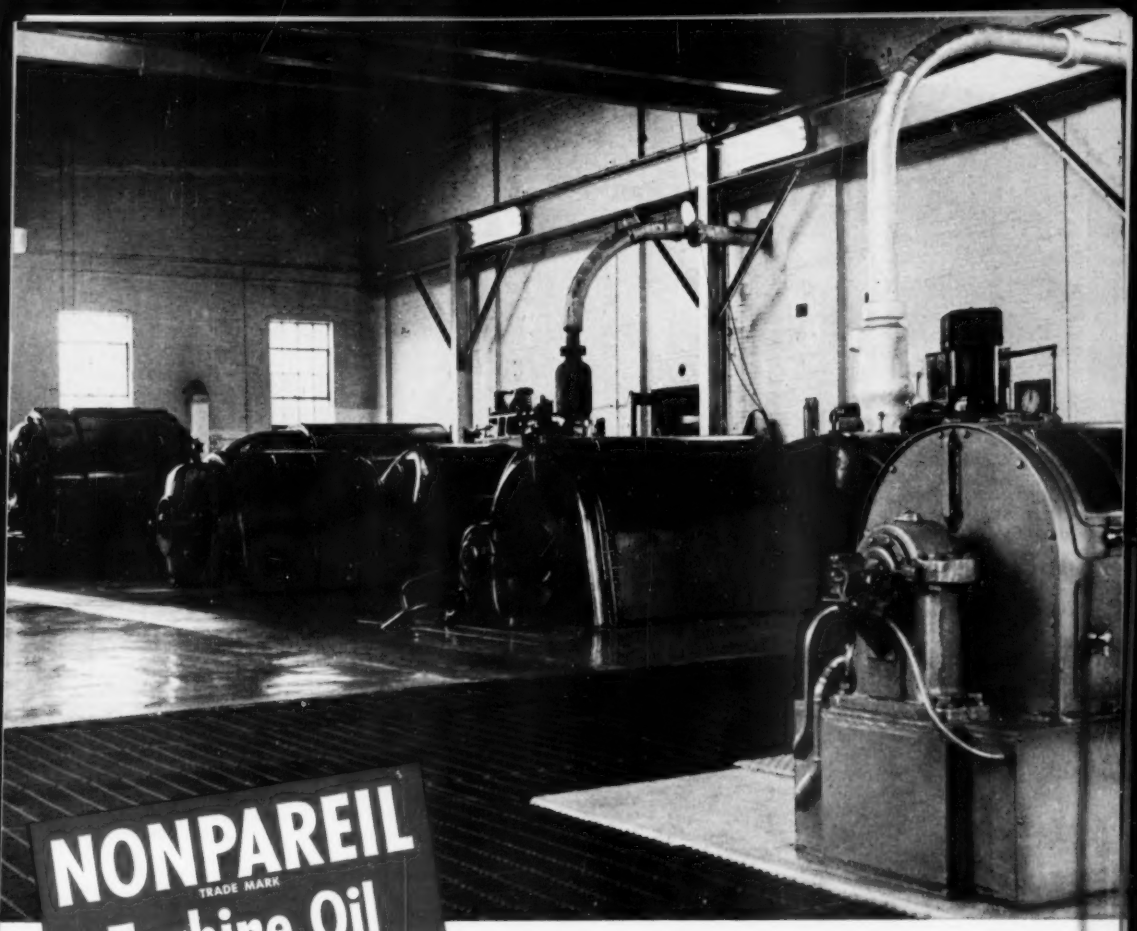
141 Small Purifiers — Six-pp Bulletin 500 describes company's small line type Hi-eF purifier used to clean up small pipelines carrying live or exhaust steam, vapors and air. Discusses advantages resulting from use of these purifiers, including increased production efficiency, lower maintenance costs and improved products. Also contains diagrams of typical installations, specifications and prices. The V. D. Anderson Co.

COATINGS, CORROSION PREVENTIVES

142 Tar Base Coatings — Eight-pp Form PC-4 on cold applied tar base coatings, describes the properties of the four types manufactured by company and gives application directions. A full-page chart lists a comprehensive selection of typical structures and corrosive agents and recommends coatings best suited for each application. Pittsburgh Coke & Chemical Co.

143 Protective Paint — Bulletin 201, 8 pp, describes characteristics, applications and methods of use for a tough, corrosion-resistant protective plastic paint. Pointing out how it protects against marine atmospheres, tropical climates, chemical attack, abrasive action, salt water corrosion and other conditions, bulletin explains systems for painting metals, concrete, brick,

(Continued on page 116)



Completes first 20 years on this job

AFTER TWENTY YEARS of service in the first turbine installed by a midwest power plant, the original fill of NONPAREIL Turbine Oil is still on the job. There's no retirement in sight for this veteran.

During this time the acidity number has never exceeded 0.10 mg. KOH/gm. Removal of the oil for treating or for cleaning of the turbine lubricating system has never been necessary, and make-up requirements have remained at a minimum. That's low-cost, trouble-free turbine lubrication . . . the same kind of lubrication these plant operators are getting in three newer turbines with NONPAREIL.

There's no time limit on results like these when you use NONPAREIL. It's guaranteed in writing to last as long as the turbine itself, and the neutralization number is guaranteed never to exceed 0.15 mg. KOH/gm. For low-cost, trouble-free lubrication of *your* turbine, ask your Standard Oil lubrication specialist to explain the advantages of NONPAREIL. Let him show you operating records covering periods of continuous service well over twenty years. Call your nearest Standard Oil Company office. Or write: Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Ill.

STANDARD OIL COMPANY STANDARD *(Indiana)*

Select FOR ACCURACY...

AND YOU'LL ALWAYS BUY AMERICAN DIAL THERMOMETERS

Consistent accuracy – long-life service – have been associated with American Dial Thermometers for one hundred years! Every one is backed by the engineering skill and knowledge of materials, manufacturing and applications gained in more than a century of service to industry.

American Dial Thermometers are made in ranges from minus 60° to plus 1000°F. Selection is easy because we produce the greatest variety and offer the widest range of actuation in the dial thermometer business.

Mercury Actuation for rapid response, powerful action, extreme accuracy.

Vapor Pressure Actuation for accurate indication of temperatures at the most critical operating points.

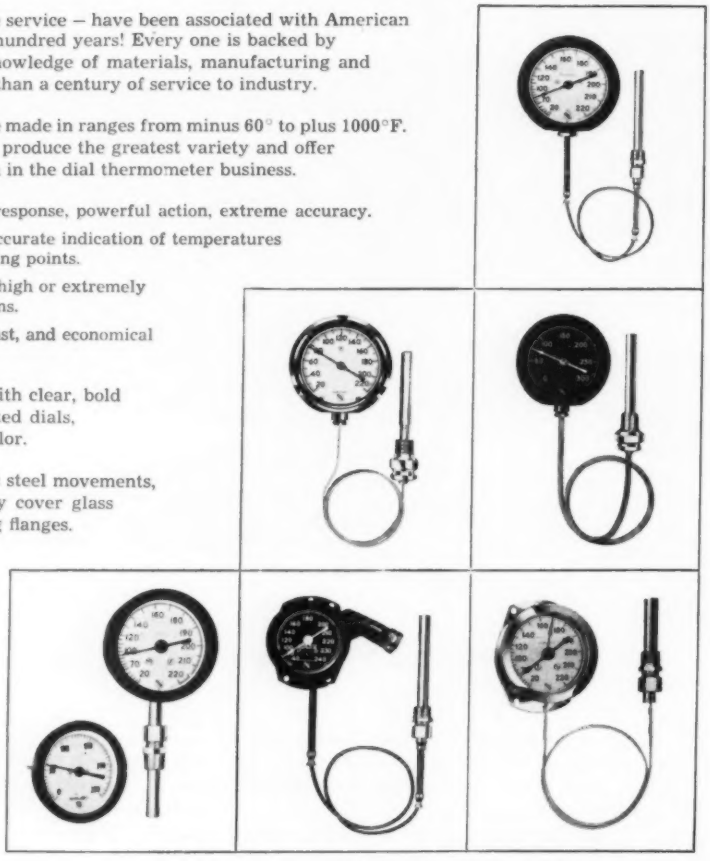
Gas Actuation for extremely high or extremely low temperature indications.

Bi-Metal Actuation for easy, fast, and economical installation.

Easy Readability –provided with clear, bold numerals, accurately graduated dials, and pointer of contrasting color.

Rugged Construction – stainless steel movements, climate-resistant cases, heavy cover glass fronts, unique flush mounting flanges.

New Catalog contains full details about the complete American line, including industrial glass, dial and recording thermometers; electronic temperature indicators and recorders. Write for a copy.



Pictured here are some of the many American Dial Thermometers stocked and sold by leading distributors.

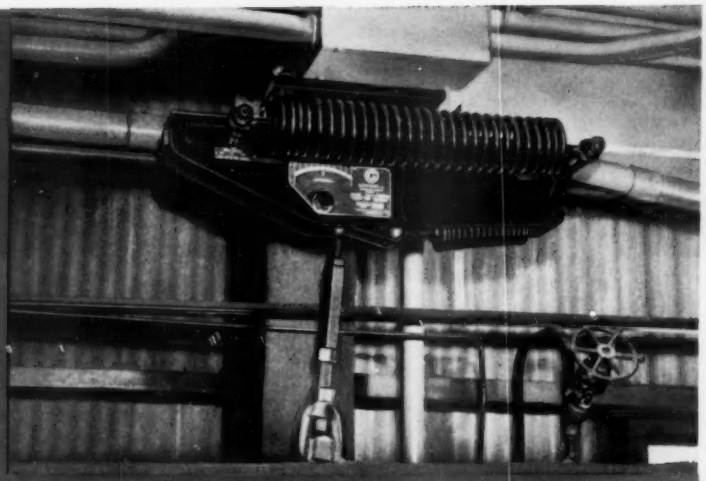
AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, CONSOLIDATED SAFETY AND RELIEF VALVES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

PIPING THAT MOVES

. . . calls for supports that are flexible



Grinnell Model I Constant-Support on 12-inch main steam at Somerset Power Station, Montaup Electric Co., Somerset, Mass. Pressure, 1300 psi; temperature, 950°F; load, approximately 4000 pounds. Note minimum headroom available.

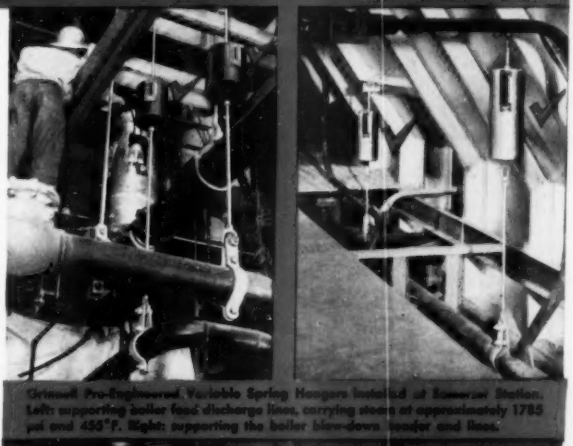
Thermal deflection of piping in today's high pressure, high temperature power stations necessitates flexible support of piping.

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant-support type hangers are recommended. They are designed to provide substantially uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

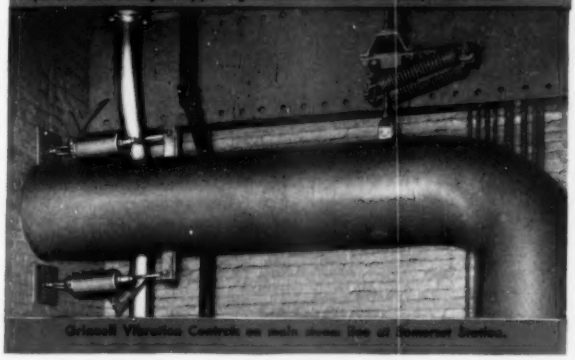
When pipe lines are subject to vertical movement and restrictive conditions do not require the use of a constant-support type, variable spring hangers are recommended. They should be designed to support not less than 85% or more than 120% of the designed load for the total travel.

When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting, counter force type are recommended.

Grinnell manufactures a complete line of engineered pipe hangers and supports; maintains a laboratory staff of trained technicians; provides highly skilled assistance and advice right from the design stage; and offers experienced field engineering service.



Grinnell Pre-Engineered Variable Spring Hangers Installed at Somerset Station. Left: supporting boiler feed discharge lines, carrying steam at approximately 1785 psi and 455°F. Right: supporting the boiler blow-down header and lines.



Grinnell Vibration Controls on main steam line at Somerset Station.

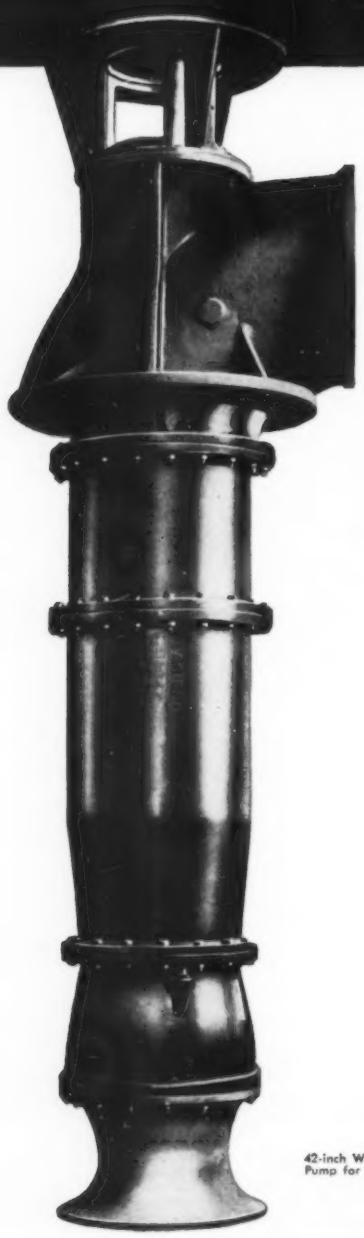
GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIERS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

C. H. WHEELER & *CONSOLIDATE TO*



Economy Pumps, Inc. and C. H. Wheeler Manufacturing Company have consolidated engineering and manufacturing facilities in C. H. Wheeler's plant at Philadelphia. Facilities are now being expanded through new construction and the installation of additional modern machine tool equipment.

PUMPS . . . Economy has for many years been among the leaders in the engineering and manufacture of centrifugal, axial and mixed flow pumps. Today, the Wheeler-Economy line is one of the most modern and complete in the pumping industry.

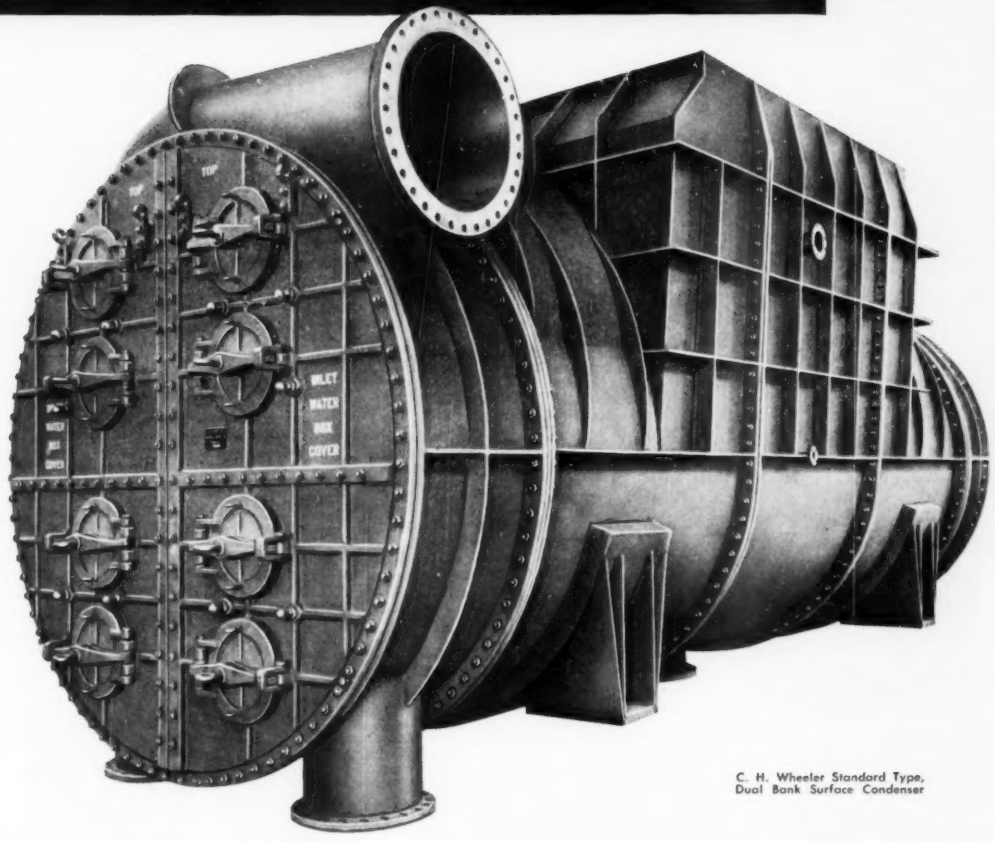
CONDENSERS & POWER PLANT EQUIPMENT . . . The C. H. Wheeler Manufacturing Company has contributed many of the outstanding developments in the field of condensing apparatus and vacuum problems. Nearly a decade ago, C. H. Wheeler adopted Economy mixed flow pumps for use with their condensers.

PROCESS EQUIPMENT . . . C. H. Wheeler is also internationally known for Cooling Towers, Steam Jet vacuum apparatus and Fine Particle Reduction Mills, vital links in modern chemical and food processes. Wheeler-Economy Pumps will round out the company's services in these fields.

MARINE GEAR . . . C. H. Wheeler's Marine Gear, Condenser and Deck Machinery department will be augmented by Wheeler-Economy Pumps designed for marine application.

42-inch Wheeler-Economy Vertical Mixed Flow Pump for condenser circulation. 32,500 G.P.M.

ECONOMY PUMPS, Inc.
SERVE YOU BETTER . . .



C. H. Wheeler Standard Type,
Dual Bank Surface Condenser

WHEELER-ECONOMY PUMPS

. . . a new name combining old names that have been known and respected for generations. All the experience and metal working techniques this consolidation brings together are of great importance to you — our customer. Wheeler-Economy Pumps will fill your every requirement regardless of size or problem involved. Write to Philadelphia or to the nearest Economy or Wheeler representative listed in the phone directories of principal cities.

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WHEELER-ECONOMY PUMPS

ECONOMY PUMPS, INC. · DIVISION OF C. H. WHEELER MANUFACTURING CO.
19TH AND LEHIGH, PHILADELPHIA 32, PA.

Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on page 119 for your request. Just list the numbers of the items you'd like to know more about

1—IMPROVED RESINS

Highly basic anion exchangers for removing silica from water

The removal of silica from water in the ion exchange demineralizing process is said to be complete down to a fraction of 1 ppm with these two new resins. Permutit S-1 is described as especially resistant to reduction in basicity and capacity for silica removal when operated for a long period of time on many waters. Permutit S-2 has a higher capacity and greater regeneration efficiency than Permutit S-1. Regeneration of these resins is accomplished with a solution of sodium hydroxide which removes the silica from the exchanger and restores its activity. Data sheets on both resins are available. The Permutit Co.

2—CYCLOMETER REGISTER

For watthour meters, features increased legibility

A new cyclometer register is available for mounting on company's single-phase Type I-30 and most polyphase (V-type) watthour meters. The new register incorporates figures four times the size of many cyclometer-register figures, and a magnetic storage and release effect to eliminate partially turned or obscured figures.

Designated the Form 25, this new unit is interchangeable with the superseded cyclometer register as well as the pointer register on the I-30 and most V-type watthour meters using alnico magnets. Meter and Instrument Dept., General Electric Co.

3—CHEMICAL FEEDER

Packaged unit, delivers liquids in desired amounts under pressure

Described as ideally suited for feeding boiler water treatment as well as delivering processing fluids, this self-contained, extra-heavy Baco unit is designed to offer high pressure controlled feed at low cost. Its chemical reservoir tank is of welded steel, available in 50 or 100 gal capacities, and the chemical proportioning pump can be designed for various rates of feed at different pressures. Fluids are mixed by a motor-driven agitator and a stainless steel strainer is provided between the suction side of the pump and the tank. The pump is mounted below the tank to minimize air binding and maintain a positive suction head.

A duplex-pump model with divided tank is also available. Both types are supplied with piping. A descriptive bulletin on them is available. The Bird-Archer Co.

4—AIR BREAK SWITCH

In 196 kv and 230 kv ratings, with or without grading rings

These new higher-rated models have recently been added to manufacturer's Type WAG Air Break Switches. The Type WAG is a high pressure, vertical break, three insulator switch with center insulator rotating. Designed for sectionalizing, main line disconnecting and by-passing service, the WAG is suggested for use in substations, on transmission lines and distribution feeders. It is available for horizontal upright, vertical or inverted mounting positions, and can be supplied for right or left hand operation. It comes in standard NEMA ratings from 7.5 through 230 kv, from 400 to 4000 amp. Southern States Equipment Corp.

5—HANDY TEMPLATE

Triangles and diamonds; useful to engineers and draftsmen

A general purpose template, the No. 51 has triangles from $\frac{3}{32}$ to 1 in., with increments in 32nds to $\frac{3}{4}$ in. and increments of $\frac{1}{8}$ in. from $\frac{3}{16}$ to 1 in.

Diamonds range in size from $\frac{1}{4}$ to 1 in. in increments of $\frac{1}{8}$ in. Diamonds up to 2 in. may be made by using triangles back to back. Made of 0.030 matte finish plastic, cut-outs are smooth and have pencil allowance for accuracy. The No. 51 Template is 4 by 7 in. in size, costs $1.50. RapiDesign, Inc.

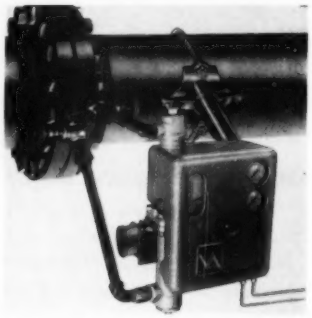
6—ORIFICE METER

Measures by-pass flow around orifice, rather than static head

Instead of measuring the static-pressure differential across the orifice, the new V/A Cell meters a continuous by-pass stream around that orifice. Thus metering is kinetic and a constant flow continuously purges the lead lines.

Manufacturer explains that a linear relationship exists between the metered by-pass flow and the main flow past the orifice — avoiding the square-root relationship between manometer action and orifice flow. The linearity and consequent ten-to-one rangeability is inherent in the new method. This method also permits simple adjustment of the by-pass rate to give the unit great flexibility. Another feature credited to the V/A Cell is adaptability to pneumatic connection to points remote from the orifice run.

In the steam power water treatment and water supply fields these characteristics are said to mean the elimination of condensate pots in exposed locations; greater chart accuracy at low flows, and thus more exact ratio control; enough rangeability to handle variation of demands with the season or the connected load; and simple central panel control through pneumatic linkage.

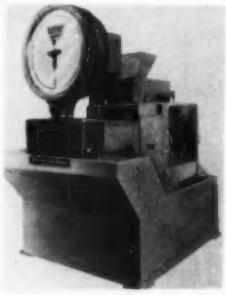


The principal parts of the V/A Cell are a variable-area meter whose float position inside a tapered tube changes with flow; a balanced follower arm, magnetically linked to the float; and a pneumatic unit for transmitting flow-rate measurement to remotely-located receivers. Fischer & Porter Co.

7—WEIGHING SYSTEM

Provides automatic cumulative and consecutive weighing

The Select-O-Weigh places automatic weighing methods within range of even small plants by having one scale do the work formerly requiring up to 12 separate scales, manufacturer states. The heart of the Select-O-Weigh is described as a simple electronic circuit with no arcing contacts and suited to explosion-proof installations. Company's standard type automatic scale is the weighing element, with a pendulum dial scale acting as force-measuring component.



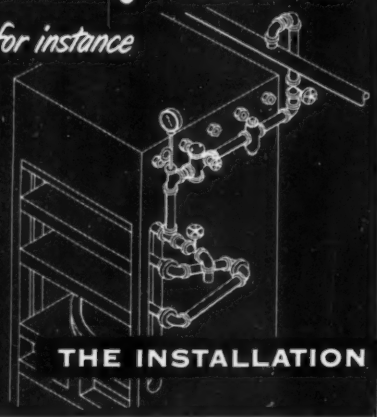
In operation, a master control panel for any particular system is built to include as many setting dials as ingredients in formulae — the system will handle from two to 12 ingredients. The scale operator sets each dial on control panel to correspond with amounts of each ingredient required. Sequence of adding materials and their timing are selectively controllable.

A "start" button actuates the screw feeder mechanism, delivering to the scale the amount of material set on the first control dial and then stopping. Then, the scale either discharges to a

Will Your Pressure Regulators Last 25 Years?

...on Molding Press Service

for instance



THE INSTALLATION

Crane Brass Pressure Regulators on steam lines to rubber molding presses; Dryden Rubber Division, Sheller Mfg. Corp., Chicago. 225 units in service.

VALVE SERVICE RATINGS

FEATURES:	Equally good on steam or air
SUITABILITY:	Steady outlet pressure - No drift
MAINTENANCE COST:	Routine servicing only
SERVICE LIFE:	Many installed more than 25 years — Still O.K.
OPERATING RESULTS:	Fully automatic steam control at lowest cost
PRICE:	Good Buy - has no equal
AVAILABILITY:	Stock item in Crane Line

THE HISTORY

Steam generated at 130 psi is reduced through individual regulators on molding presses. Pressure used at machines is 60 to 100 psi depending on work. Features of regulator service needed most are: (1) nonfluctuating outlet pressure automatically maintained within close regulation; (2) easy adjustment by press operator to specified pressure for given work.

More than 25 years ago the plant standardized on Crane Regulators, a total of 225 being in use today. Many are the original installations, still delivering desired outlet pressure. Records for all regulators, regardless of age, show no maintenance cost other than prescribed simple routine servicing. On old models of the Crane 960 regulator, after prolonged service, this includes occasional regrinding of seats.

THE VALVE

Crane No. 960 Brass Pressure Regulators reduce steam or air pressures up to 250 psi, to within 80% of inlet pressure. Factory pre-set to operate within any of 4 ranges from 1 to 200 psi, with easily selected service pressure within set range. Precision made; fully automatic; highly dependable, even under reasonable fluctuation of inlet pressure. All wearing parts renewable. See your Crane Catalog or Crane Representative for full data.

The Complete Crane Line Meets All Valve Needs. That's Why—

More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois

Branches and Wholesalers Serving All Industrial Areas

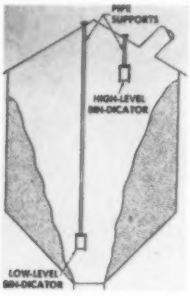
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

mixer or goes on to handle the next ingredient. Following discharge of the automatic scale a tare check circuit is utilized to prevent the scale from initiating the next weighing unless all material is cleared from the weigh hopper. Richardson Scale Co.

8—BIN-LEVEL INDICATOR

For providing dependable level indication in large bins

The Model CS Bin-Dicator, designed for suspended installation from above, can be located anywhere in the bin where there will be a free flow of material to and away from the diaphragm. This flexibility of location permits its use in bins containing materials which tend to



build up on the walls of the bin and flow down through the central area only. Under these and similar conditions, indicators mounted on the bin wall couldn't function properly, company points out, but the new model, mounted in the area of moving material, gives indication of high and low levels.

The unit is designed to be drilled and tapped to take any size pipe up to 2 in. The support pipe also accommodates electrical wiring. The Bin-Dicator Co.

9—TWO-LAMP BALLAST

Provides for trigger-start operation of both lamps

Two-lamp fluorescent fixtures using company's 22-w and a 32-w Circline lamp

WANT MORE details on these products? Use the postage-free cards on page 119.

can be powered with one ballast — the new No. 89G333. It is designed to provide instant, simultaneous starting of both lamps. Company points out that the brickette-style unit is considerably smaller than conventional switch-start ballasts for the same lamp combinations and weighs only $3\frac{1}{2}$ lb. It is said to provide extremely quiet operation. It measures $8\frac{1}{4}$ by $2\frac{3}{8}$ by $1\frac{5}{8}$ in. and operates on 110–125 v, 60 cycles. Specialty Transformer and Ballast Department, General Electric Co.

11—CALENDERED TAPE

Offers good chemical resistance and high dielectric strength

Temflex 105 Tape is based on the same formulation as company's Temflex 105 Tubing. Its oil resistance suggests its use with oil, as in transformers or diesel equipment, and the high tensile strength is said to make its use on taping machines more effectively. Although not easily stretched, the material possesses good ultimate elongation, company points out.

Being calendered, Temflex 105 uniformity of thickness credited with virtually eliminating internal stresses caused by uneven tensions. Technical data and samples are offered. Irvington Varnish & Insulator Co.

12—SPACE HEATER

For large industrial applications; will heat 16,000 to 24,000 sq ft

A new model Thermobloc, capable of producing 2,000,000 Btu per hour, the Model 2000 features a smooth exterior and a new interior design. It has twin heat exchangers arranged in the form of a V — a design said to result in maximum scrubbing of the heating surfaces by air passing through. Four discharge diffusers give pin-point control of air throw and may be placed in any desired position, and single ducts may be run from outlets to adjoining rooms.

Manufacturer of the Thermobloc 2000 points out that it requires less floor space and less head room than most space heaters. Its normal air output is 22,000 cfm and intake velocity is 440 fpm. The fan is powered by a 10 hp motor. The unit can use light fuel oil (with pressure atomizing gun-type burner); heavy oil (using rotary cup burner) or gas (using power burner). It may also be equipped with a combination burner. Thermobloc Div., The Prat-Daniel Corp.

13—THREADED STEEL ROD

For industrial repair, installation and construction

Designed to save shopmen time and money on jobs requiring long bolts or rods, or bolts of special shape, the Redi-Bolt comes in straight 36-in. lengths and in six diameters from $\frac{1}{4}$ to $\frac{3}{4}$ in., precision threaded the full length. It is made of cold-drawn steel and protected against rust by a special coating.

Manufacturer states that long straight bolts and adjusting rods can be made

quickly by hacksawing Redi-Bolt to size, and fitting with standard nuts. Or, after heating the rod with a blowtorch, it can be bent into U-bolts, L-bolts, eyebolts or other shapes. The part is ready for immediate installation.

Redi-Bolt can be used to hang overhead equipment, such as electrical conduit and bus ducts, steam and water pipes and power packs. It can also be used to mount power panels, transformers and ducts, and to anchor machinery, power poles and shelves. Redi-Bolt.

14—STAND-BY LIGHT

Supplies emergency light when fuses blow or power failures occur

The Watchmaster Automatic Stand-By Light has a glass jar rechargeable battery and visible ball float hydrometer. Electrical components — including relays, transformers and battery chargers — have been specially engineered for constantly energized stand-by duty, company states. The battery has heavy lead plates, hard rubber separators, automatic filling control. A built-in trickle charger is provided to maintain specific gravity between emergencies and a built-in charger to restore the battery quickly. Either floodlight or sealed beam lamp heads are available, and either condulet connection for per-

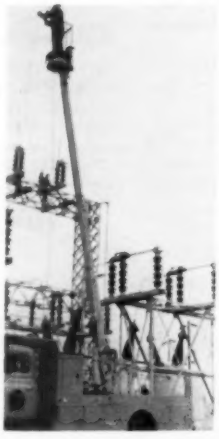
10—HIGHWORK EQUIPMENT

Takes a man right up to the job, lets him work there free-handed

The Industrial Monkey consists of a hydraulically operated telescoping boom with a self-leveling cage. The boom has a 270 deg turning radius and a horizontal-to-vertical working span. The operator positions the cage by means of six insulated foot controls.

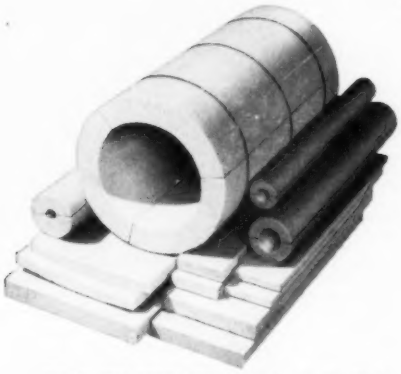
Several safety features are emphasized by manufacturer. The self-leveling cage is mounted on heavy-duty insulators and has a Micarta platform designed to offer protection against more than 24,000 v. The workman is encircled by a waist-high one-piece guard rail. Besides the foot-operated switches controlling the boom, the operator has a signal switch to the truck cab and an emergency switch to stop the truck engine. A duplicate set of controls are located in the truck cab.

Boom and cage will carry a 200-lb man, and are self-locking in case the engine stops. Two models are available, measuring 33 ft 2 in. and 39 ft 2 in. ground to cage platform. Manufacturer says the Industrial Monkey retracts to a compact traveling position, can be mounted on a 2 ton truck. Donwill Co.



Does Your Present Heat Insulation Have All These Advantages?

Kaylo Heat Insulation is a hydrous calcium silicate — a revolutionary heat-saving material — outstanding both in performance and ease of application.



KAYLO PIPE INSULATION is made to Simplified Dimensional Standards of thicknesses and diameters for snug nesting, when necessary.

1. **LOW "K" FACTOR**—Billions of sub-microscopic air spaces which compose the structure of Kaylo Heat Insulation give it exceptional insulating value.
2. **TEMPERATURE RANGE UP TO 1200° F.**—Kaylo Heat Insulation eliminates the need for combination coverings in nearly all operating conditions.
3. **LONG SERVICE LIFE**—Kaylo Heat Insulation remains dimensionally stable, strong and efficient over the years—although exposed to temperatures up to 1200°F.
4. **INSOLUBILITY IN WATER**—Even when saturated, Kaylo Heat Insulation retains about 85% of its strength. It returns to its original strength after drying.
5. **HIGH STRENGTH**—Breakage of Kaylo Heat Insulation is almost negligible in shipping and installation—workmen can walk on insulated equipment without causing breakage.
6. **LIGHT WEIGHT**—Since Kaylo Heat Insulation weighs only 11 pounds per cubic foot, it is exceptionally easy to handle and apply.
7. **WIDE RANGE OF SIZES AND SHAPES**—Kaylo Heat Insulation's unmatched selection of sizes and shapes reduces the number of pieces required per job.
8. **EASE OF CUTTING AND FITTING**—Ordinary tools of the trade are used to install Kaylo Heat Insulation. The material is non-irritating to the skin and non-toxic.

For complete details on all of the advantages of Kaylo Heat Insulation, write Dept. N-293, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

see our CATALOG in SWEET'S FILE

KAYLO® ... *first in calcium silicate*

...*pioneered by* OWENS-ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

manent wiring or plug attachment for semi-portable installation. Lamp heads are removable and extra heads available for remote mounting. The Carpenter Mfg. Co.

15—PYROMETER CONTROLLER

Indicating, direct-reading, with built-in straight line control

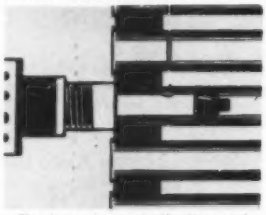
The Model 293 Capacitrol is designed to offer a means of securing a type of proportioning control for processing equipment, formerly obtainable only through use of auxiliary devices or more costly equipment.

The instrument operates with the same "electronic link" incorporated in company's previous Capacitrol Controllers, but adds the new Line-otrol feature to automatically reduce to a minimum the "on" and "off" variation of the control instrument above and below the present control point. Wheelco Instruments Co.

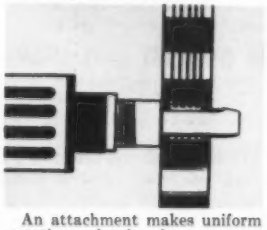
16—TUBE CUTTER

For condenser and heat exchanger repair jobs

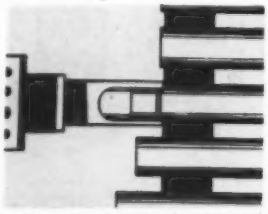
Light in weight and portable, the Type AA Pneumatic Tube Cutter is designed for the cutting of ferrous and nonferrous tubes.



By inserting spindle into tube and moving feed handle forward, rolled or packed tubes are cut internally behind tube sheet.



An attachment makes uniform serrations of tube sheets at any specific depth. Serrating blade is self-centering.



The trimming stop is suggested for trimming uneven or belled tube ends outside tube sheets at any specified length, or flush with tube sheet. Armstrong and Sons.

17—SAFETY RELIEF VALVE

For hot water space heating boilers, tanks, heaters

The Cash-Acme Type F-51 is available in pressure settings from 30 to 125 lb, with corresponding Btu ratings at various pressure settings. It was developed to conform with National Board and ASME recommendations

that safety valves be sized according to the Btu generating capacity of the boiler. With the Type F-51 it is simple to install a valve which has a greater relieving capacity in Btu's per hour than the particular boiler can generate, company explains.

This safety relief valve is said to have sufficient capacity to relieve pressure due to thermal expansion of water, as well as steam caused by failure of the firing device to shut off. It is an all bronze valve, incorporating high lift design, stainless steel spring and silicone disc seat. A. W. Cash Valve Mfg. Corp.

18—SAFETY HAMMER

Features new type of construction within hammer head

Utilizing the "controlled compression" principle the improved Flex-Flo is a malleable metal hammer with hollow chambers, the inner walls of which are corrugated. Under continuous heavy pounding, the opposing angles of these corrugations slowly approximate each other at a predetermined rate to retard the compression of the malleable hammer head, and prevent mushrooming.

The Flex-Flo is made of a non-ferrous copper-base alloy. It won't spark, chip or flake and has a high degree of tensility, company says, adding that since no metal is lost, it retains its original balance and weight. It is also reported to have a long service life. The Flex-Flo Safety Hammer comes in six sizes from ¾ to 6 lb. Custanite Corp.

19—IMPROVED ASKAREL

Is developed for power transformers and load centers and capacitors

This new liquid, 1470 Pyranol, is reported to be the result of 11 years of research and tests, and to offer such improved technical characteristics as lower viscosity at lower temperatures and a lower pour point, allowing easier handling under adverse weather conditions. Advantageous qualities of company's earlier 1467 Pyranol have been retained in the new product, including noninflammability.

Use of askarel in power equipment eliminated necessity of fireproof vaults and long secondary runs of copper, company points out. Low maintenance costs and less noise are other advantages credited to Pyranol units. Pyranols 1470 and 1467 are miscible and can be used interchangeably in existing equipment. Transformer and Allied Products Div., General Electric Co.

20—LEAD LUBRICANT

Is heavy duty grease type, with lead in suspension

The significant factor of Lead-Lube is its high metallic lead content in the form of a pulverized lead dust, kept in permanent suspension. Manufacturer explains that while lead has long been regarded as a fine lubricant its use in metallic form has been retarded by lack of a method to keep it from settling out of suspension, adding that Lead-Lube is homogenous blend.

The function of the metallic lead in this lubricant is to form self-lubricating surfaces over all wearing parts of gears and bearings, so actual surfaces will be protected from wear. In older equipment, the metallic lead acts to resurface pits and scores, to restore some of the parts' previous efficiency. In addition to wear, gears and bearings are frequently exposed to corrosion due to water, moisture or corrosive chemicals. Tests of Lead-Lube are reported to show that it increases life of machinery under these conditions. Knapp Mills, Inc.

21—TEST KIT

Speeds trouble diagnosis and maintenance checks on G.M. diesels

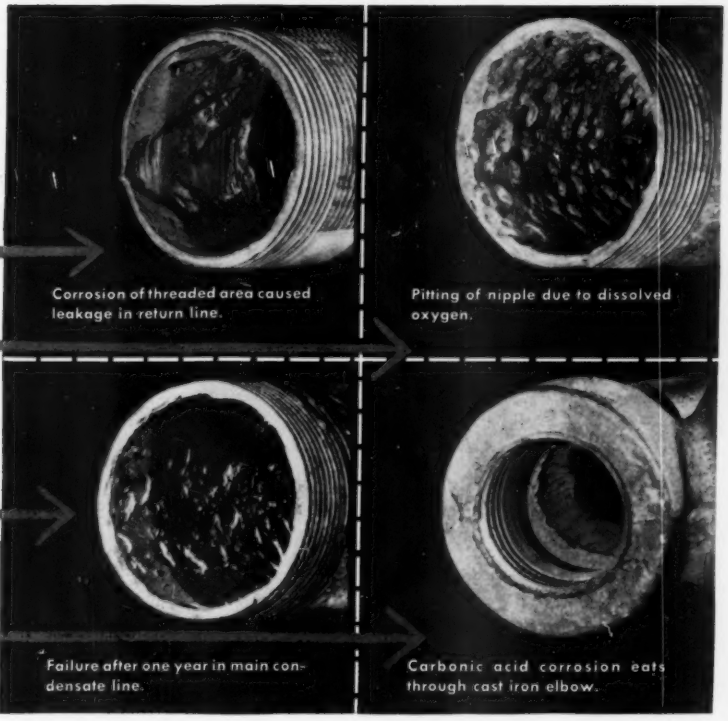
A new basic test kit, the No. J-4209-41 includes all equipment required for checking timing, exhaust back pressure,

engine rpm, blower intake restriction, air box, oil, crankcase pressure, plus cylinder liner position on all Series 71 and 6-110 General Motors diesel.

Testing equipment is mounted in a metal box. It includes: zero to 15 lb and zero to 100 lb U. S. pressure gages, magnehelic gage, zero to 3600 rpm tachometer with flexible extension and adapters, dial indicator with attachments and cylinder liner gage block. A bulletin provides further details on this kit. Kent-Moore Organization, Inc.

FURTHER DATA on these products is yours for asking. Use postage-free cards on page 119.

victims of Return Line Corrosion



Corrosion of threaded area caused leakage in return line.

Pitting of nipple due to dissolved oxygen.

Failure after one year in main condensate line.

Carbonic acid corrosion eats through cast iron elbow.

Dearborn Formula 702 will prevent Corrosion caused by low pH values

Excessively low pH values of water—caused by dissolved carbon dioxide—result in corrosion that destroys return line sections such as these.

The destruction of such valuable parts is easily and economically prevented with Dearborn Formula 702. Introduced directly into the boiler feed water, Formula 702 forms a continuous amine-type film on the return lines to effectively coat the lines against corrosion. In addition, Formula 702 will automatically repair any surface where the film has been broken by loosened rust scale, and also improve heat transfer in the line, thereby reducing the cost of steam production.

Your Dearborn Engineer will gladly demonstrate how you can reduce the cost of maintenance and avoid shutdowns with Dearborn Formula 702. Why not call him today?

DEARBORN CHEMICAL COMPANY

Merchandise Mart Plaza • Chicago 54, Illinois

BASIC PATENTS

Dearborn holds the basic patents (U.S.Pat. 2400543) for the use of filming amines for treating water.

YOU'LL WANT A COPY OF THIS BULLETIN **Bulletin 5013, which outlines the causes of return line corrosion and the method of cure with Formula 702, will be sent on request.**

Dearborn Chemical Company Dept. PG
Merchandise Mart Plaza
Chicago 54, Ill.

☐ Send a copy of Bulletin 5013
☐ Have a Dearborn Engineer call

Name.....

Position.....

Company.....

Address.....

City.....*Zone*.....*State*.....

Dearborn

TRADE MARK REGISTERED

THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

POWER PLANT *Construction News*

Saco, Ala. — Stauffer Chemical Co., Inc., 420 Lexington Ave., New York, N. Y., plans boiler house at proposed new plant at Saco, where site has been acquired, to be used for processing and production of carbon bisulphide and kindred specialties. Entire project reported to cost close to $1,000,000. Work scheduled to begin soon.

Pine Bluff, Ark. — Arkansas Power & Light Co., Pine Bluff, is arranging expansion and improvements in plants and system during next 48 mos., to cost approximately $90,000,000. Of this amount, $27,000,000 will be expended in 1952, and $33,000,000 in 1953. Plans are maturing for expansion at Lake Catherine steam-electric generating station, with installation of two new 135,000-kw. turbine generators and auxiliary equipment. Additional power substations will be constructed, and extensions made in transmission lines.

Los Angeles, Calif. — Southern California Edison Co., 601 West 5th St., has arranged an expansion and improvement program during present year to cost about $80,000,000, including extensions in generating capacity, power substations, transmission lines, and other operating facilities.

Golden, Colo. — Colorado Central Power Co., has authorized fund of about $950,000 for expansion and improvements in plants and system during present year, including extensions in generating stations, power substations, and transmission lines.

Atlanta, Ga. — Georgia Power Co., Electric & Gas Bldg., has arranged fund of $46,000,000 for expansion and improvements in plants and system during 1952. Of this amount, approximately $5,000,000 will be used in connection with a new 40,000-kw. steam-electric generating station near Brunswick, Ga.; also, about $6,700,000 for two new 100,000-kw. turbine-generator units and auxiliary equipment, to be installed at Plant Hammond, near Rome, Ga. Remainder of fund will be expended for other power plant development, power substations, transmission lines, and other operating facilities.

Ford, Ky. — Eastern Kentucky Electric Cooperative, Inc., has begun construction of proposed new steam-electric generating plant at Ford. Installation will include high-pressure boilers, turbine-generators, and auxiliary equipment. Power substations and switching stations will be constructed for service to about 26 rural electric cooperatives in Eastern and Central part of State. Entire project is reported to cost about $15,000,000. Financing has been arranged through Federal aid. Burns & McDonnell Engineering Co., 95th and Troost Sts., Kansas City, Mo., is consulting engineer.

Harrodsburg, Ky. — Corning Glass Works, Corning, N. Y., technical glass products, baking glass ware, etc., plans power house at new factory for manufacture of optical glass at Harrodsburg. It will approximate 100,000 sq. ft. floor space, and is estimated to cost close to $2,000,000. Work will be placed under way at once. Harry S. Sterling will be manager at new plant.

Louisville, Ky. — Louisville Gas & Electric Co., 311 West Chestnut St., has plans under way for new steam-electric generating plant on Ohio River, approximately 3 mi. south of present Paddy's Run power plant. Proposed to begin work in near future and to have plant ready for service in 1954. Company will carry out project in connection with expansion program during next 24 mos., for which about $32,000,000 has been authorized.

Shreveport, La. — Ralston Purina Co., 835 South 8th St., St. Louis, Mo., cereal products, animal and poultry feeds, etc., plans boiler house at proposed new livestock and poultry feed mill at Shreveport, where site has been secured. It will be equipped for a capacity of about 150,000 tons of feed per annum. Cost close to $1,000,000, with equipment. Mill is scheduled to be ready for service early in 1953.

Madawaska, Me. — Fraser Paper Ltd., has approved plans for new addition to power plant at mill, with installation of additional equipment for increased capacity. Work is scheduled to begin at early date. No estimate of cost announced. Stone & Webster Engineering Co., 49 Federal St., Boston, Mass., is consulting engineer.

Baltimore, Md. — Consolidated Gas, Electric Light & Power Co., Lexington Bldg., has arranged fund of about $65,000,000 for expansion and improvements in plants and system during the present year, for increased capacity in generating stations, new power substations, extensions in transmission lines, etc.

Manchester, N. H. — Public Service Co. of New Hampshire, is arranging fund of about $11,900,000 for expansion and improvements in plants and system during present year. Work will include increase in generating capacity, power substations, transmission lines, etc.

Keene, N. H. — Board of Trustees, Elliot Community Hospital, Keene, Chester L. Kingsbury, president of board, plans boiler plant at local institution, with installation to include two high-pressure boilers and auxiliary equipment. Estimate of cost being made.

Springfield, N. J. — Hanovia Chemical & Mfg. Co., 100 Chestnut St., Newark, N. J., industrial and ceramic chemicals, liquid gold, etc., plans boiler house at proposed new plant at Springfield, near Newark. Factory will approximate 150,000 sq. ft. floor space, and is reported to cost close to $1,600,000. Work scheduled to begin this spring. Epple & Seaman, 901 Broad St., Newark, are architects and engineers.

Greensboro, N. C. — Morton-Withers Chemical Co., High Point Rd., Greensboro, chemicals for textile and other industries, plans boiler house at proposed new plant in Gulf Coast area of Texas, where site is being selected. It will comprise several production units, and is reported to cost $1,700,000.

Spray, N. C. — Union Carbide & Carbon Corp., 30 East 42nd St., New York, N. Y., plans power house at new mill, for manufacture of staple fibre at Spray, where site has been purchased. Plant will consist of a series of one and multi-story buildings for processing and general production, with machinery and facilities for initial capacity of 20,000,000 lbs. per annum. Cost reported over $20,000,000. Work is scheduled to begin soon.

Wilmington, N. C. — Carolina Power & Light Co., Raleigh, N. C., has plans under way for new steam-electric generating station on site in New Hanover County, vicinity of Wilmington. It will be equipped for an initial rating of 110,000-kw. Project will include power substation, transmission and distribution lines.

Columbus, Ohio — Columbus & Southern Ohio Electric Co., 215 North Front St., has authorized an expansion and improvement program in plants and system during 1952 to cost about $21,700,000. Of this amount, approximately $9,200,000 will be expended for extensions and improvements in generating equipment at different stations. Power substations and transmission lines are estimated to cost about $7,500,000 of gross sum.

Dayton, Ohio — Dayton Power & Light Co., 25 North Main St., has arranged fund of about $38,000,000 for expansion and improvements in power plants and system during 1952–53, including extensions in present generating capacity, power substations, transmission lines and other operating facilities.

Liberty, S. C. — Julius Kayser & Co., 500 Fifth Ave., New York, N. Y., women's rayon hosiery, underwear, knitted cloth, etc., plans boiler plant at new dyeing and finishing mill at Liberty, where site has been selected. Proposed to begin work soon. Cost reported over $1,000,000.

Charleston, Tenn. — Bowater Southern Paper Corp., 250 Park Ave., New York, N. Y., recently organized as an affiliate of Bowater's Newfoundland Pulp & Paper Mills, Ltd., Corner Brook, Newfoundland, Canada, has plans maturing for new pulp and paper mill in vicinity of Charleston (Bradley County), previously referred to in these columns, and expects to begin work this spring. A power plant will be constructed. Entire project will cost approximately $45,000,000. Mill is scheduled for completion in 1954. J. E. Sirrene Co., 215 Main St., Greenville, S. C., is consulting engineer.

Lawrenceburg, Tenn. — Wamsutta Mills, Wamsutta St., New Beford, Mass., cotton goods, has closed negotiations with Town Officials at Lawrenceburg, for construction of new mill, to be occupied under long-term lease. It will comprise a main one-story building and several auxiliary structures, including boiler plant and pumping station. Entire project will cost about $4,500,000. Plans will be prepared soon. Roberts & Co., Associates, 96 Poplar St., N.W., Atlanta, Ga., are architects and engineers.

Amherst, Tex. — Southwestern Public Service Co., Amarillo, Tex., has begun construction of new steam-electric generating station in vicinity of Amherst. Work will include installation of high-pressure boiler, turbine-generators, and auxiliary equipment. Entire project will cost in excess of $3,000,000.

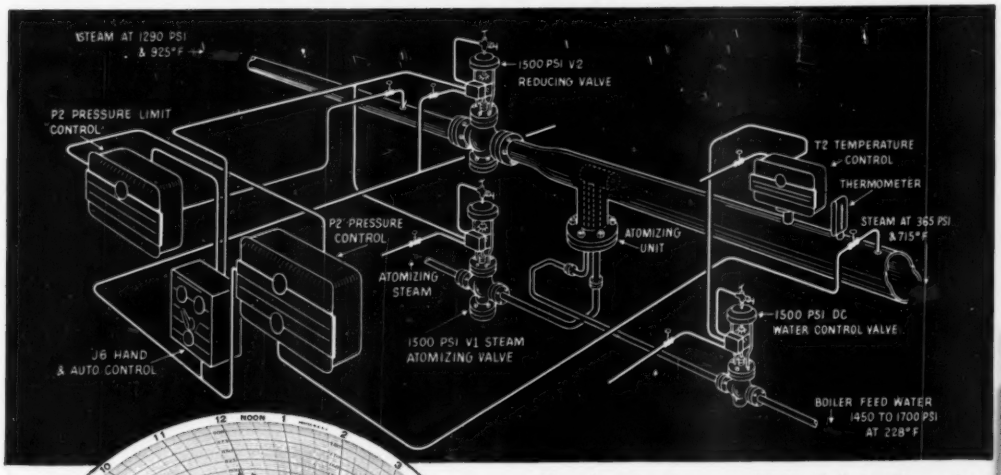
Dallas, Tex. — Texas Power & Light Co., Interurban Bldg., plans new steam-electric generating plant on site in Red River County, to be equipped for an initial capacity of 80,000-kw. Site is being acquired and construction is expected to begin soon.

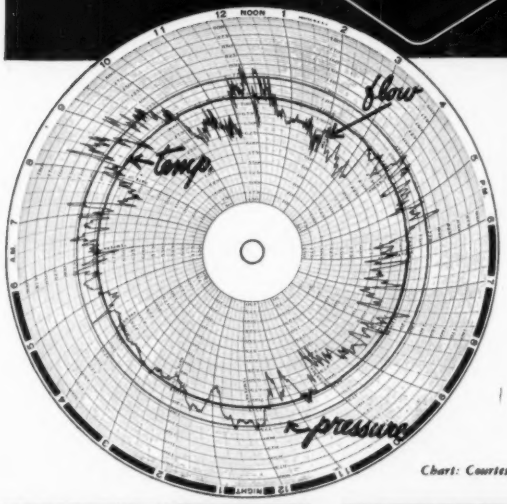
League City, Tex. — Houston Lighting & Power Co., Houston, Tex., has plans maturing for new steam-electric generating plant at League City. No official estimate of cost announced. Proposed to begin work soon. Ebasco Services, Inc., 2 Rector St., New York, N. Y., is consulting engineer.

Roanoke, Va. — American Viscose Corp., Marcus Hook, Pa., has plans maturing for new power house at rayon mill at Roanoke. Bids have been asked for structural steel framing and work is expected to begin at early date. No estimate of cost announced.

Moses Lake, Wash. — Utah-Idaho Sugar Co., Beneficial Life Bldg., Salt Lake City, Utah, plans power house at proposed new beet sugar mill at Moses Lake, where site is being acquired. It will comprise a number of large one and multi-story buildings for processing and general production. Entire project reported to cost over $6,500,000. Proposed to begin work soon.

Swartwout RDC* controls within ±1 psi and ±3°F even with widely fluctuating load swings


STEAM AT 1290 PSI & 925°F
1500 PSI V2 REDUCING VALVE
P2 PRESSURE LIMIT CONTROL
T2 TEMPERATURE CONTROL
THERMOMETER
P2' PRESSURE CONTROL
ATOMIZING UNIT
STEAM AT 365 PSI & 715°F
ATOMIZING STEAM
1500 PSI DC WATER CONTROL VALVE
J6 HAND & AUTO CONTROL
1500 PSI V1 STEAM ATOMIZING VALVE
BOILER FEED WATER 1450 TO 1700 PSI AT 228°F

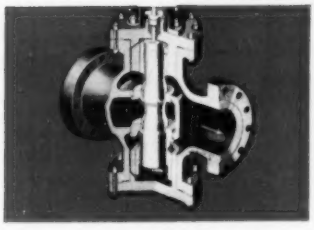


1 Chart shows how Swartwout RDC*—Reducing, Desuperheating and Control System—handles low-pressure turbine load of 65,000 to 165,000 lbs. steam per hour in Des Moines Power Station No. 2 of the Iowa Power and Light Company. It reduces from 1290 to 365 psi and desuperheats from 925° to 715°F. When main reducing valve closes, extremely light loads can be handled by pressure reducing valve supplying atomizing steam. Operation of the system is stable regardless of load change or time lag. Because of the exceptional control obtained by this large station, the Iowa Power and Light Company later purchased an additional small Swartwout RDC unit to supply steam to house turbines.

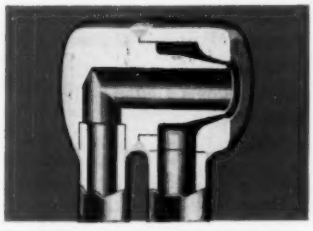
Swartwout

POWER PLANT EQUIPMENT

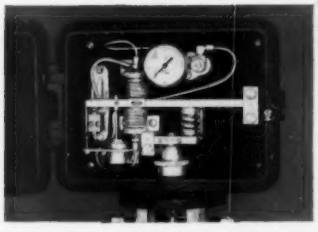
Chart: Courtesy Iowa Power and Light Company



2 Swartwout V-2 Regulating Valve has smooth, nozzle-shaped passages which guide expansion of high-pressure steam to reduced pressure zone without high-velocity impingement or other destructive forces common to conventional valves. Undue noise, turbulence and vibration are eliminated; longer valve life results.



3 Swartwout Steam Atomizing Desuperheater, constructed of stainless steel, has accurately machined passages that give narrow-angle dispersion of cooling water outside of steam atomizing head. There is no impingement of steam or water against walls of unit, no erosion of parts, no need for pipe liners.



4 Swartwout T-2 Control, with metallic temperature element in steam pipe, gives rapid and precise control regardless of magnitude of load or time lag. There are no flapper valves, relays or other delicate elements. Only two simple adjustments are involved; one for temperature, one for response.

A-3002

SEND FOR BULLETINS S-21-E, S-22-C, S-198 • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

GARLOCK EXPANSION JOINTS

STOP VIBRATION–

relieve stresses and strains in piping and equipment

ABOVE: Garlock Rubber Expansion Joints in operation on 2½" suction and discharge pipes. RIGHT: Sectional view shows sturdy construction of a single arch expansion joint. Arrow points to one of steel reinforcing rings.

Garlock Rubber Expansion Joints are made:

- With single arch for normal expansion, contraction and vibration.
- With multiple arch for excessive pipe expansion.
- With filled arch for lines carrying sediment.
- Tapered for connecting pipes of different diameters.
- "U" type for vacuum to reduce vibration and noise on pipe lines conveying coal-laden air to pulverized coal burners and other types of light construction piping.
- With control units for excessive elongation of unanchored pipes.
- With neoprene lining for lines carrying water or air with some oil present.
- With neoprene lining and neoprene cover for lines carrying slight amount of oil and where exterior of joint is subject to oil drip or oil vapor.
- With neoprene throughout for lines carrying petroleum derivatives.
- In all pipe sizes from ¾" to 72".

Specify No. 204 for *Pressure*; No. 205 for *Vacuum*; and No. 206 for *Pressure* and *Vacuum*.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

8 Big Advantages:

1. Made of high-grade rubber, they do not crack or fracture under repeated flexing.
2. They do not take a permanent set.
3. For pressures up to 125 p.s.i. (depending upon size of joint); and for vacuum of 30 in. of mercury.
4. Suitable for operating temperatures up to 180° F.
5. They do not corrode or erode.
6. They are light in weight and can be installed in a limited space.
7. They require no gaskets between the flanges of the joint and the flanges of the pipe.
8. They do not induce electrolysis.

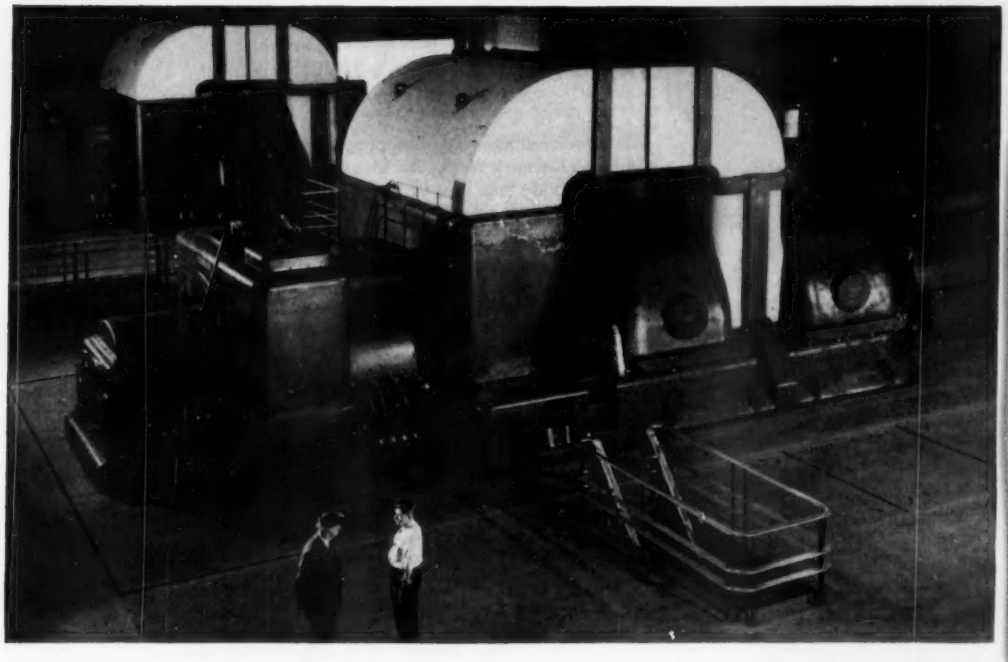
GARLOCK

**PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS,
RUBBER EXPANSION JOINTS**

the One-Two for oxidation and deposits in turbine lubricating systems

Flush with GULF TURBINE FLUSHING OIL

Fill with GULFCREST OIL



By taking these two steps, you can insure top lubricating efficiency down through the years for your new steam turbine.

The use of Gulf Turbine Flushing Oil—before the initial fill of lubricating oil — will remove grease-type slushing compounds and carry away harmful abrasives which might be in the circulating system. And, it protects all oil-bathed surfaces against rust. Because Gulf Turbine Flushing Oil is itself a satisfactory lubricant, the undrained portion does not impair the lubricating value of the turbine oil.

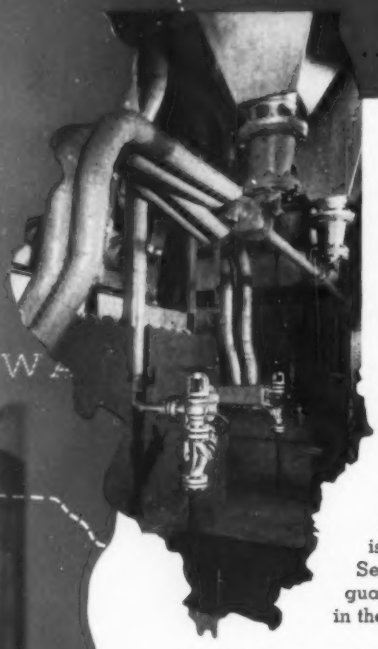
Then, to keep the new system clean, fill with Gulfcrest Oil. Because of its outstanding resistance to oxidation, Gulfcrest maintains an exceptionally low neutralization number, and lasts indefinitely. With this quality oil and good operating practice, you can be sure there will be no sludge deposits in cooler tubes, bearing pedestals, or oil lines to worry about.

To get these benefits for your new turbines, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office.

Gulf Oil Corporation · Gulf Refining Company
Pittsburgh 30, Pennsylvania.

GULF INDUSTRIAL LUBRICATION

. . . IN ILLINOIS, TOO IT'S YARWAY!



INTERNATIONAL HARVESTER PICKS YARWAY

SEATLESS TANDEM BLOW-OFF VALVES

International Harvester Company's great McCormick Works at Chicago is another long-time user of Yarway Seatless Blow-Off Valves. Yarways guard each of the four large boilers in the plant.

Good boilers are better boilers with Yarway Blow-Off Valves. Good design, careful engineering and manufacturing, modern metallurgy, dependable service—all combine to make Yarways the standard blow-off valves in more than 15,000 plants.

Yarway engineers, conveniently located near you, are constantly working for better, more profitable steam plant operation. Call a Yarway man for help on your problems.

Yarway Seatless Blow-Off Valve features balanced sliding plunger. *There is no seat to score, wear, clog or leak.* Write for Bulletin B-425 for pressures to 400 psi.; Bulletin B-433 for higher pressures.

YARNALL-WARING COMPANY
114 Mermaid Ave., Phila. 18, Pa.
BRANCHES IN PRINCIPAL CITIES

YARWAY SERVICE GOES ALL THE WAY . . .

LETTERS TO THE EDITORS

OBSTINATE PROBLEMS

I WAS keenly interested in Mr. Kogan's article, How to Solve Obstinate Problems, in the February issue, for it seemed that besides providing practical suggestions in engineering, he was furthering philosophy, in that he was putting his finger on some of the mental processes that distinguish the goats from the sheep among us humans.

What made the article personally intriguing to me lay in his early mention of Gauss and the addition of consecutive numbers, with the mysterious withholding of the process I was assuming Gauss had used. It was not until the end that I learned the reason for the author's injection of suspense — he had not stayed with his own method of reasoning quite long enough to come up with the answer. If he had stuck with it, he probably would have reasoned not that Karl Freidrich was thinking "4 x 10 plus 5 equals 45," but that *5 x 9 equals 45*.

It stems from the practice, where and when I went to school, of regularly and intensively subjecting the student to competitive mental arithmetic; and possibly Gauss was likewise cursed or blessed. The competition was particularly harsh in that the winner took the entire purse, and there was nothing for the 2nds, 3rds and also rans. To excel was everything. And it was perfectly legal and ethical to get to the finish line by running a shorter distance than your competitors, IF you could find the short cut and negotiate it after you found it.

So you searched for short cuts having a factor of absolute accuracy. And your memory told you that addition is but a slow method of multiplication. Then, among other things, you found that the sum of consecutive numbers is simply the product of their median times their tally. And that while shorter cuts exist in certain series, the median always equals half the sum of the initial and terminal numbers, and the tally equals one more than their difference. . . .

So, in adding 1 through 9, it seems that Gauss had a mental image of 5 by the end of the first second, and a 9 appeared by the end of the second, and the answer of 45 was on the screen by the end of the third. His particular problem was comparatively short, as you may agree after fixing the system in your memory, and then surprising yourself with the time required to add 1 through 100. But regardless of the simplicity of the example, you will have solved a specific problem of speed — that is, until someone comes along with a faster solution.

Bodfish, Calif. CLAYTON G. LANDRY

Kogan Replies to Landry

I GENERALLY receive comments from engineers that the examples I give are self-evident. Mr. Landry caught the deeper meaning behind these examples by stating, "he was putting his finger on some of the mental processes." For the book comes as a result of attempts to watch my thinking. Ideas flow so fast that it is hard to take even mental notes. I had to train myself for this job.

He brings up the point that Gauss could have seen 5 nines instead of 4 tens and 1 five, when adding 1, 2, 3, 4, etc., and that, if I had stuck with it, I would have reasoned out that he could have used 5 nines. Of course, this article was short, however, in the book on page 65, I definitely show that possibility.

What I wanted to bring out was not what method Gauss used, but that Gauss saw it as an approach to other problems. If you count the change in your pocket, the person who uses the grouping approach will not add his change in consecutive order, or say 5 and 10 is 15, 15 and 5 is 20, and so on, but will say I have 2 nickels and 2 dimes, and that is 30. He can apply the grouping approach to his daily life or work.

Chicago, Ill. ZUCE KOGAN

Comments by Libby

I HAVE GIVEN this matter considerable thought myself and have found that there are certain mental processes which can be employed which often help at arriving at a solution. For instance, suppose that you want to transmit one form of motion from one plane and direction to another plane and direction. You say to yourself, "How can I do this job? I can employ mechanics, electricity, pneumatics, hydraulics. If I employ mechanics I can employ bevel gears, spur gears, shafts, cams, cranks, wabble plates, chain and sprockets, belt drive and so on. If I employ electricity I can use contacts and solenoids, servo mechanism, electronics, generators and synchronous motors," and so on down through the list.

If a person forces his mind to explore all the avenues, regardless of how silly they may first seem, he is not likely to become bogged down on one idea when an almost obvious idea is waiting just around the corner. Think of the years that heavy road equipment was entirely mechanical before some bright lad thought of introducing hydraulics. Think of the years that bark was scraped off pulp logs until someone thought of doing it with high-pressure water.

Another mental trick that is worth deliberately employing is, if a device cannot be made to do the job, can the job be changed to fit the device? For instance, the ordinary slotted screw would fall off the screw driver. The screw driver could not be changed and still fit the screw, and so the socket head screw and screw driver were developed. No known device can tell one gas from another while it is in a pipe in the ground without opening the pipe. But when a radioactive gas is introduced at the source, the gas can be traced with a Geiger counter. As long as the problem was attacked purely from the angle of the screw driver or the gas analyzing apparatus, it defied solution.

Each person who is called upon to solve problems should list, at least mentally, the questions which are applicable to his particular job. The chemist would have a different list from the mechanic and so on down the line, but the same principle prevails in every walk of life. If the searcher uses this old and tried technique, if he develops the ability to think in an orderly manner, he is less likely to say of someone else's idea, Why didn't *I* think of that?

Vancouver, B. C. H. T. LIBBY

RED FACE DEPARTMENT

Some Traveling!

JUST TO PROVE I go through your magazine, if not read every word, I note that on Fig. 3, page 81 of the March issue, the 3500-lb automobile is moved a distance of 60 miles in 1 min by a force of 300 lb.

Boy! that sure am traveling!

Schenectady, N. Y. B. G. HATCH

Editor's Note: — A sharp rap on the knuckles to all draftsmen, proofreaders and editors — including this writer — who had anything to do with this. Of course, it should have read 60 miles in 1 hr or 5280 ft in 1 min.

However, it may be worth a *gaffe* like this to prove that Mr. Hatch of the Marketing Section, Gas Turbine Department, General Electric Co., certainly does look through POWER ENGINEERING.

Finally, our apologies to Mr. Engelman, author of the article, one of the Basic Power Plant Figuring series.

George Daniels on Future of Modern Plants—A Correction

WE WISH to correct a serious error in the statement by George Daniels of Commonwealth Associates, on page 60 of the January issue. The last sentence of that statement as it was published, reads as follows: "There is nothing at the present time to indicate that the heat rate of modern plants cannot be materially improved." Unfortunately this is not what Mr. Daniels said. What he actually said was this, "There is nothing at the present time to indicate that the heat rate of our most modern plants *can* be materially improved." The error was ours and was made in transcribing.

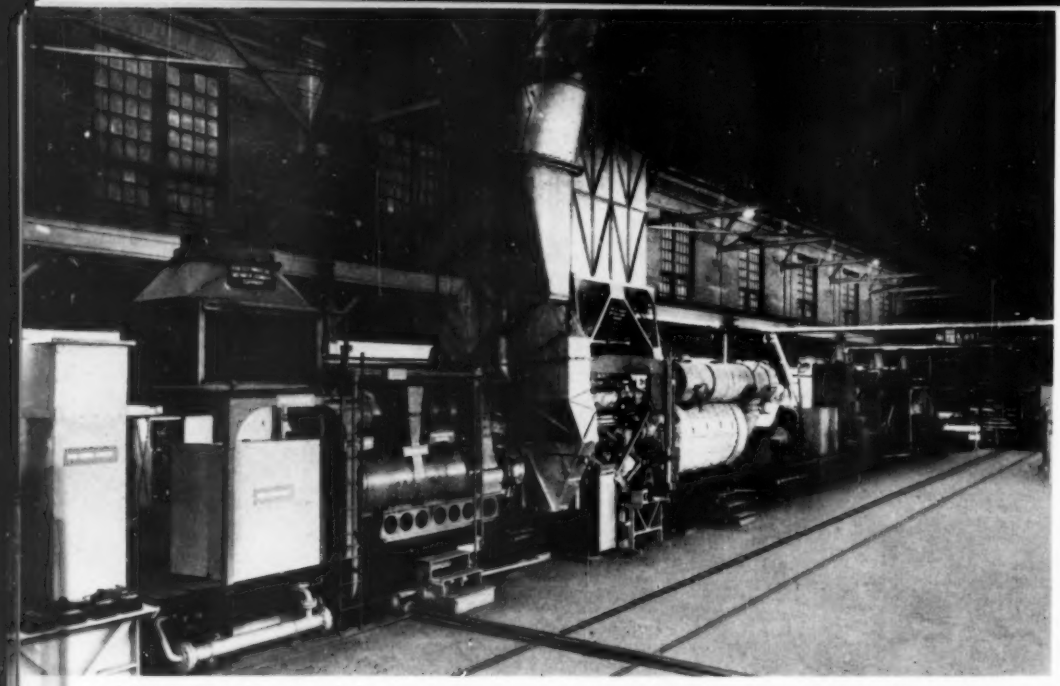


Fig. 1. Test installation of complete L. D. C. coal-burning locomotive gas turbine at Dunkirk, N. Y., now undergoing test runs burning bituminous coal

L. D. C. Gas Turbine Runs on Coal

At Dunkirk, N. Y., the Locomotive Development Committee's full-size locomotive gas turbine has been under test operation, burning bituminous coal, for 178 hr . . . Inspection then showed clean turbine rotor blades, only one very small erosion spot on one cyclinder blade . . . Tests show maximum over-all cycle efficiency of 22.7 per cent at 3121 turbine shaft horsepower, turbine inlet temperature 1300 F . . . Turbine maximum horsepower 4121, 1300 F inlet temperature, 5700 rpm, overall cycle efficiency 20.9 per cent . . . Unit in operation again, following inspection, undergoing 750-hr test

By JOHN I. YELLOTT, Director of Research and **PETER R. BROADLEY,** Assistant Director of Research
Locomotive Development Committee, Bituminous Coal Research, Inc.

Fig. 2. Variation of turbine inlet and outlet temperatures with shaft horsepower is shown by curves

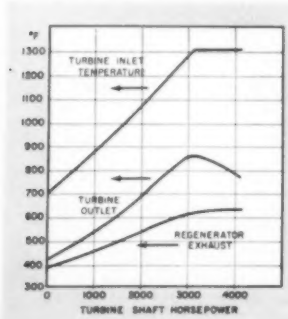
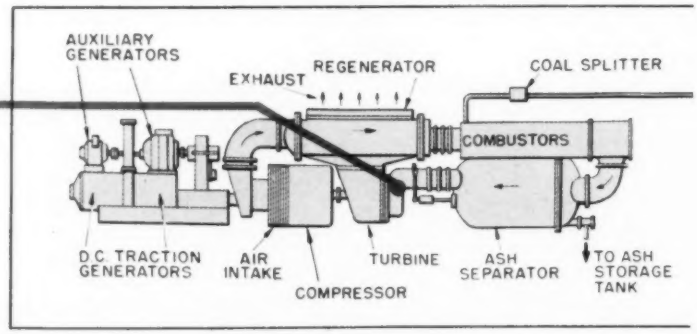


Fig. 3. General arrangement of L. D. C. gas turbine power plant and coal preparation equipment as installed and undergoing tests, burning bituminous coal, at Dunkirk. Note separator ahead of turbine



LOCOMOTIVE Development Committee's program of research and experimental turbine operation has been described in previous papers presented before the Midwest Power Conference (now the American Power Conference). This year, for the first time, test results are given for a 4250-hp locomotive-type coal-burning gas turbine.

Installation and coal-fired operation of the Houdry process turbine were described in 1951. In the month following last year's presentation, a successful 250-hr test was run in which blade erosion was reduced to acceptable proportions. (This was fully described in POWER ENGINEERING, July 1951, in article Coal-Burning Gas Turbine Steps Ahead Fast in 1950 and 1951, referred to hereafter as Ref. 1.) Installation of the Allis-Chalmers locomotive-type turbine was then completed and oil-fired operation was begun to "shake down" the machine and to determine its operating characteristics.

After initial operating difficulties were overcome and acceptance test run, the unit was subjected to a series of coal-fired tests which totaled 178 hr. The turbine was then dismantled to make a careful inspection and to carry out necessary alterations. The turbine was found to be in excellent condition, with no sign of deposits on the blading and only one very minor evidence of erosion.

This article gives highlight on the installation, test results obtained, and condition of the machine after 178 hr of coal-burning operation, abstracted from a progress report to the March 1952 American Power Conference.

Power Plant Installation

Objective of the Locomotive Development Committee (L. D. C.) is to develop a coal-burning gas turbine for railroad service. The Dunkirk test installation was therefore designed to conform to locomotive clearance requirements. The power plant and the coal preparation equipment are mounted on separate steel underframes, 10 ft wide and 50 ft long, simulating locomotive construction, Fig. 1. Aside from the ducts, which lead outside air to the compressor intake and return the exhaust to the atmosphere, all the equipment can fit within a two-unit locomotive.

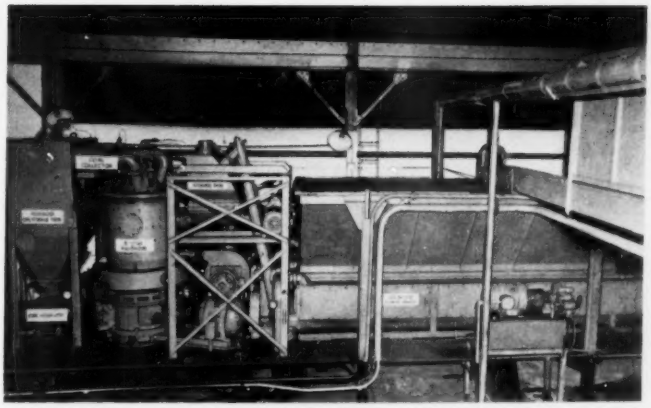


Fig. 4. Details of coal preparation equipment for coal-burning gas turbine. Starting at right: coal bunker, stoker, storage tank, mill, coal collector, pulverized coal storage tank, coal pump feeding combustors

The six-stage reaction turbine, Fig. 3, is designed to operate at 5700 rpm, with a maximum inlet temperature of 1300 F. The rotor was machined from a forging of Timken alloy 16-25-6); the cylinder blading was precision-cast from S-590, while the rotor blades were forged and final-machined from the same alloy. The turbine casing was fabricated from 19-9 DL.

The 21-stage axial compressor is coupled at its intake end to the turbine shaft; the discharge end of the rotor drives the four main generators through a reduction gear. The auxiliary generators (two 175-kw alternators, a 35-kw d-c generator and the Regulex exciter) are mounted above the main generators and driven by secondary gears.

The regenerator is installed immediately above the turbine exhaust, the weight and end-thrust being taken by the steel framework. A bellows-type expansion joint provides the necessary flexibility between the turbine and the regenerator. The air from the compressor discharge enters the regenerator inlet header through a flexible elbow.

Ash Separation Equipment

Preheated air flows from the regenerator outlet header through expansion joints to the twin combustors. Film-cooled combustors are used, as described in Ref. 1. Concentric dual-fuel burners are used in which the main coal burner surrounds the auxiliary oil burner.

Ash separation takes place in the large vessel shown in Fig. 3. Its internals consists of twenty-six 10-in. diameter Dunlab tubes, mounted in parallel. See Ref. 1. Combustors, louvers and internal components of the fly ash separator are made of Inconel and Type 347 stainless steel. Tees, elbows and shell of the separator were fabricated from Inconel X, since this was the strongest available material that could be formed into these shapes. This equipment was built at Dunkirk under L. D. C. supervision by the Alco Products

Fig. 3—Continued. General arrangement of components in coal preparation system, all designed to fit on locomotive as shown in Fig. 4. System is designed to take run-of-mine coal, prepare it for combustors

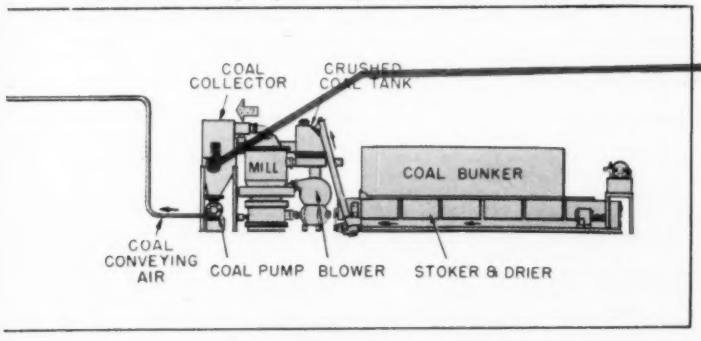
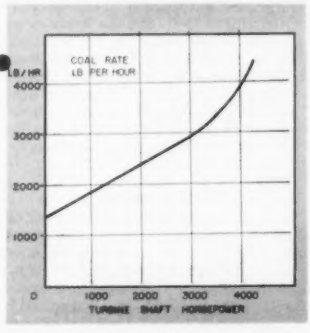


Fig. 5. Coal consumption vs turbine shaft horsepower, 80-F inlet air, is shown by this curve



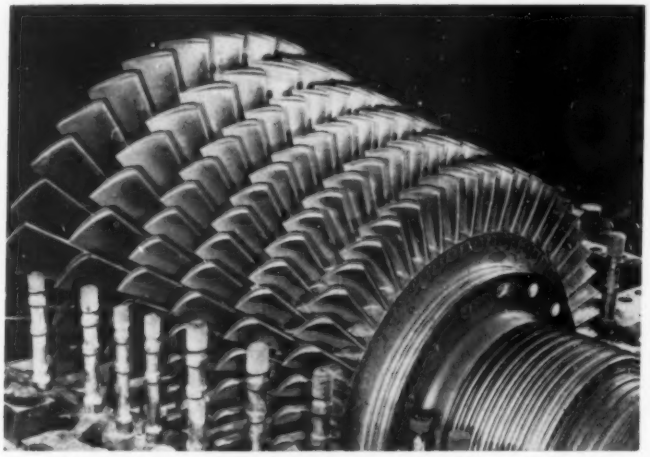


Fig. 6. This shows the locomotive gas turbine rotor immediately after 178 hr of coal-fired operation

Division of American Locomotive Co.

Detailed designing of the combustion and ash separation equipment was carried out at Schenectady by the engineering staff of the American Locomotive Co., working closely with L. D. C. engineers. The design was complicated by the combination of high loads, caused by relatively high pressures and large diameters, and large thermal expansions, caused by the high temperatures and high coefficients of expansion. Expansions of the combustion and ash separation equipment are different from the expansion of the turbine and regenerator. All these relative movements are accommodated by using toroidal expansion joints.

Coal Preparation System

Coal preparation system, shown in Figs. 3 and 4, is designed to take regular locomotive run-of-mine coal, dry and pulverize it, and deliver it to the combustors at the rate required by the turbine, Fig. 5. The system and its operation were described in detail in Ref. 1.

Original objective was to produce a self-contained locomotive that could take run-of-mine coal and do all the processing on the locomotive. A reevaluation of this aim is under way to determine if it will be more economical to use way-side preparation facilities and carry pulverized coal on the locomotive. This arrangement will greatly simplify operation and maintenance and reduce the locomotive's cost to a figure comparable with that of a 4500-hp diesel-electric locomotive.

Performance

The plant can burn either coal or oil. It is necessary to start the plant and bring it up to self-sustaining speed by burning Diesel fuel. The fuel control system is then transferred from oil to coal and load is applied.

The entire plant is instrumented so that the performance of each component can be determined. All the instruments and controls are centered at the Operator's Panel so that one man can run the entire plant.

The four traction generators are loaded by General Electric air-blown grid resistors, extreme left Fig. 1. The electrical output is measured by calibrated instruments.

The unit responds almost instantly to load changes, but the response to changes in fuel rate is considerably slower. The plant is equipped with an automatic control system, which has not yet been made fully operative.

Over-speed protection of the turbine is provided by two separate safety devices. On several occasions, the machine has been tripped out at full load, and the over-speed system has brought it down.

Test Results

After the initial operating difficulties were overcome, a series of tests was run using diesel fuel. These covered the entire load range during a period when weather conditions caused compressor inlet temperature to vary from 60 F to 100 F.

Official acceptance test was run on September 28, 1951, between 11:30 a.m. and 1:00 p.m. During this period conditions remained substantially constant at 5710 rpm, 1285 F turbine inlet temperature, and 59 F inlet air temperature. Actual generator output was 3973 hp, giving a turbine shaft output of 4404 hp. Combustion efficiency by heat balance determination was 95.1 per cent. The cycle efficiency was 20.17 per cent. Correcting for heat loss from the fly ash separator, which was not insulated during the test, the cycle efficiency would be 21.2 per cent.

When the test results were corrected to the contract conditions (5700 rpm, 1300 F turbine inlet, 80 F compressor inlet) the unit was found capable of producing 4250 hp, or 13.5 per cent above the warranted output of 3750 hp. During the full load test, the turbine produced about 16,000, hp of which the compressor took 11,600 hp. Turbine efficiency was 87.5 per cent; compressor efficiency was 84.0 per cent; regenerator effectiveness was 55 per cent, with pressure drops of 3.06 per cent on the air side and 6.5 per cent on the gas side.

Using the data from the variable load tests, Allis-Chalmers engineers calculated the performance of the plant over the entire load range for fixed inlet air conditions of 14.7 psia, and 80 F. The results of their calculations are shown in the table. Variation of turbine temperatures with load is shown in Fig. 2. The plant heat input is given in the table with the cycle efficiency based on this heat input. Coal consumption of the plant is shown in Fig. 5, for 95 per cent combustion efficiency, burning coal with a higher heating value of 12,800 Btu per lb (11,800 Btu per lb effective heating value at 1300 F).

Maximum cycle efficiency is

Table showing estimated performance of L. D. C. gas turbine power plant with 14.7-psia, 80-F inlet air

Turbine Shaft Horsepower	21	1090	2130	3121	3830	4121
Speed, rpm	4500	4500	4500	4500	5100	5700
Airflow to Compressor, lb. per hr	213200	207000	205300	203300	251700	288600
Airflow to Compressor, cfm	48400	46900	46600	46100	57100	65400
Turbine Inlet Temperature, F	700	900	1100	1300	1300	1300
Turbine Exhaust Temperature, F	413	558	705	856	800	760
Regenerator Exhaust Temperature, F	386	465	541	614	622	632
Compressor Discharge Pressure, psia	52.9	55.5	58.3	60.8	75.1	86.7
Heat Input to Air, million Btu per hr	16.43	22.48	28.85	34.91	43.66	50.10
Cycle Efficiency, per cent	0.02	12.3	18.8	22.7	22.3	20.9

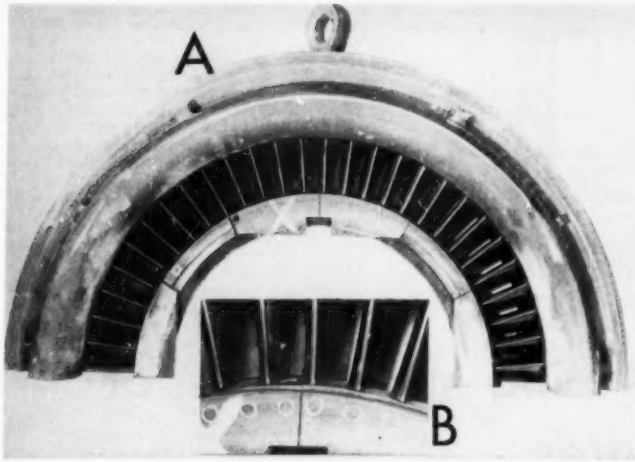


Fig. 7. Cylinder blading after 178 hr of coal-fired operation. A — Front view of 1st row cylinder blading, upper half. B—Close up of blades of A at "12 o'clock". Only two small spots of erosion were found

reached at 75 per cent of full power. Beyond that point, the compression ratio rises beyond the optimum value and the regenerator makes a smaller contribution to the cycle.

As soon as the acceptance test had been successfully completed, the fuel controls were turned from oil to coal and the plant was operated for a total of 178 hr on Pittsburgh-seam, high-volatile bituminous coal. The machine operated as well with coal as with oil, and, in general, it was impossible for a casual observer to tell whether the plant was burning oil or coal. The stack was relatively clear and the ash disposal system worked satisfactorily. Combustion efficiency, as determined by ash analysis, was consistently above 95 per cent.

Operating Experiences

Trouble was encountered with damp coal and a number of alterations had to be made in the coal system. The width of the coal feed-pump rotor had to be increased to 5.0 in., and the method of venting the pump was altered. Duration of the coal-fired tests ranged from a few hours to a maximum of 43 hr. Average temperature at the turbine inlet ranged between 1050 and 1100 F with loads varying from 1500 to 2500 hp depending upon turbine speed and outside air temperature.

A number of mechanical difficulties were encountered, including troubles with auxiliary generator lubrication, overspeed trips, hot air leakage at the turbine inlets, and rubs of increasing severity in both turbine and compressor. Following a demonstration of the plant to the L. D. C. on November 20, 1951, it was decided to dismantle the machine for a careful internal inspection.

Figure 6 shows a photograph of the turbine rotor, which was taken as soon as the cover had been lifted. The blades are entirely free from deposits and erosion. A slight discoloration of the last row of blades, extending inward about one-half inch from the tips, was the only indication that the turbine had been running on heated air.

Experience with the Houdry unit, Ref. 1, had led to the expectation that erosion might be encountered in the cylinder blading, but a careful examination of the entire turbine showed only one very small spot of erosion. Figure 7A shows the appearance of the upper half of the first row cylinder blading as seen from the inlet end. There is some brightening of the leading edges but the only erosion was that which can be seen on the two blades located at "12 o'clock", as shown in Fig. 7B.

We now have reason to believe that during this time the fly ash separator was not functioning properly and we were passing, through the turbine, contaminated hot gas containing more ash of a large particle size than the Dunlab tube will emit if it is functioning properly. The product being passed through the locomotive turbine was coarser and in greater quantity than passed through the Houdry unit. The necessary corrective action has been taken and the recent samples are of optimum quantity and size.

There were no deposits of ash anywhere in the turbine and the labyrinth seals were all perfectly clean.

The rubs in the turbine and compressor were quickly located, and clearances were increased where it was found necessary. The leakage of hot air at the turbine inlet was traced to a bolting condition which was corrected. The machine has been reassembled and is now undergoing a 750-hr high-temperature, high-load test.

FIRST MARSHALL-PLAN POWER PLANT FOR ITALY

SIGNIFICANT milestone in the Marshall Plan-Mutual Security Program for Western Europe was reached February 24 as a new generating unit of the Societa Edison electric power company was officially opened in Genoa, Italy.

The new 60,000 kw thermal unit in Genoa is the first Marshall Plan-financed new electric power project in Europe to go into operation.

It is also the first of 720,000 kw of thermal electric power being added to Italy's capacity under a $64,000,000 financing program of the Economic Cooperation Administration (now the Mutual Security Agency). All this new capacity will be brought into operation during the rest of this year and early in 1953, under present plans.

Although the Genoa plant is now being fueled with oil, it is designed to consume low-grade coal mined in Sardinia, Italy's Mediterranean island. Use of this coal is economically desirable, as it means Italy will not have to use its scarce foreign exchange to import fuel.

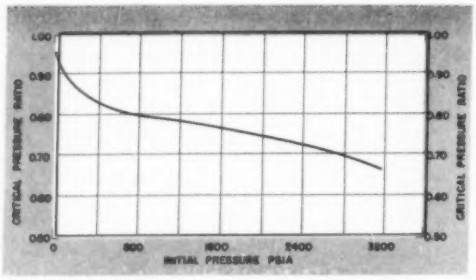
The Sardinian coal, being high in ash content, requires enormous combustion space for efficient use. Top-flight American engineers worked out special boiler designs so the Genoa plant could use this fuel, which a few years ago would have been considered commercially worthless.

Gibbs & Hill, Inc., consulting engineers of New York, supervised the design and construction of the plant.

United States firms who have sold the American equipment used in the plant, principally the Westinghouse Electric Corp. and the Combustion Engineering-Superheater, Inc. also have provided specialized services.

Actually, the ECA-MSA-sponsored capacity being constructed, 720,000 kw, represents less than one fifth of the Italian postwar power construction program, which totals 4,180,000 kw. As the Marshall Plan dollar aid represents about 50 per cent of the cost of the MSA projects, the dollar aid will pay for roughly 10 per cent of the new power capacity being built in Italy. This aid has been applied in critical situations of the power program, and has carried with it into the program a large amount of capital from Italian sources. Furthermore, it has afforded employment for Italian labor during a critical period.

Serious droughts during the postwar years showed that the Italian power plants were entirely too dependent on water power. Officials of Italian utilities, the Ministry of Public Works and ECA agreed that emphasis should be placed on steam plants in the expansion program. The goal is a ratio of 25 per cent of capacity in steam plants, 75 per cent in hydroelectric plants, compared to a 1951 ratio of 14 per cent and 86 per cent, respectively.



Curve of critical pressure ratios for flow of saturated liquid water covering pressures up to critical point for use in designing pipe for flashing mixtures

By W. F. ALLEN, Jr.

Engineer, Mechanical Division
Stone & Webster Engineering Corp.

How to Size Piping and Valves for Flashing Mixtures

Flashing mixtures of water and steam, that is . . . Such mixtures are the principal ones the power engineer has to deal with, in extraction heater circuits, blowoff lines and the like . . . Flashing mixtures cause erosion in piping and valves, reduced flow capacity and the like . . . This article gives formulas for figuring pipe and valve sizes to minimize these troubles, compares test and calculated data for specific installations . . . Shows numerical calculation for case in which flashing may be eliminated . . . This is the first of two articles; second will show how to size for cases in which flashing occurs after and ahead of control valves, including a handy chart for valve sizing

OBJECTIVE of the design engineer is to provide the most economical piping system that will pass the required flow and in which the possibility of erosion resulting from high water-steam mixture velocities is minimized. Experience has demonstrated forcibly that sizing piping and valves for the flow of initially-saturated liquid water by the usual criteria for liquid flow, or by empirical formulas, is unsatisfactory, for in numerous cases pipes and valves thus selected have failed to pass the design flow. Design procedure and simple rational design formulas and charts for pipe and valve sizing which will always ensure adequate flow capacity are presented in this article. (See also Ref. 1; at end of article.)

The design engineer is handicapped by the fact that a completely rational scheme of piping design to eliminate erosion difficulties has not been devised. However, the following comments may furnish a partial solution of the problem for many piping arrangements.

Unquestionably, the most effective way of reducing possible erosion diffi-

Table I. Here are the formulas you need; and Table III shows how, by putting numbers in them, you obtain a practical pipe size for use in actual piping

Design Formulas for Sizing Piping for Flashing Mixtures of Water and Steam

(1) Formula for pipe exit critical pressure and pressure at valve throat

$$p_c = \frac{W}{A} C p_1$$

$$C = \left[\left(\frac{h_{f1} - h_{f2}}{p_1 - p_2}\right)\left(\frac{2v_{fg1}}{h_{fg1} + h_{fg2}}\right)\frac{1}{g}\right]^{1/2}$$

(2) Formula for flow capacity of unthrottled pipe line; also may be used to determine pressure drop in unthrottled pipe line

$$\left(\frac{W}{A}\right)^2 = \frac{\frac{g}{C_1^2}\left[C_1(p_1 - p) - C_2 \log_e\left(\frac{C_1 p_1 + C_2}{C_1 p + C_2}\right)\right]}{\log_e\left[\left(\frac{p_1}{p}\right)\left(\frac{C_1 p + C_2}{C_1 p_1 + C_2}\right)\right] + \frac{2fL}{D}}$$

(3) Formula for ideal flow capacity of control valve (C_1 and C_2 defined as in (2) above)

$$\frac{W}{A} = \frac{p}{C_1 p + C_2}\sqrt{2g\left[C_1(p_1 - p) + C_2 \log_e\left(\frac{p_1}{p}\right)\right]}$$

$$C_1 = \frac{v_{f1} + v_{f2}}{2} - \left[\left(\frac{h_{f1} - h_{f2}}{p_1 - p_2}\right)\left(\frac{2p_1 v_{fg1}}{h_{fg1} + h_{fg2}}\right)\right]$$

$$C_2 = \left(\frac{h_{f1} - h_{f2}}{p_1 - p_2}\right)\left(\frac{2p_1 v_{fg1}}{h_{fg1} + h_{fg2}}\right) p_1$$

Definition of Symbols Used in Formulas

D = diameter, ft
C = coefficient as per equations
g = acceleration given to unit mass by unit force, ft per sec per sec
f = coefficient of friction
Subscript f = refers to a property of the saturated liquid
Subscript g = refers to a property of the saturated vapor
Subscript fg = refers to property change due to change of state from saturated liquid to saturated vapor
p = absolute pressure, psf (pounds per square foot)
v = specific volume, cu ft per lb
h = enthalpy, Btu per lb
V = velocity, fps
W = mass rate of flow, lb per sec
A = area of cross section, sq ft
L = total equivalent length, ft

culties is to subcool the saturated liquid. For some piping systems this is not feasible; but, in a turbine extraction feed heating system, a subcooling zone may be added to a condensing heater and a dual benefit realized from the reduced possibility of erosion and the reduction in heat rate resulting from the decreased degradation of energy in the form of flashed drains.

Design to Minimize Erosion

The piping should be as free from bends and elbows as is compatible with flexibility requirements and the physical arrangement of equipment, because erosion occurs principally at points in the flow path where an abrupt change of direction takes place. Benjamin and Miller (2) have suggested as a criterion a limiting momentum force of 75 lb on a 90-deg elbow $[\sqrt{2}\ (wv \div g)]$ based on their examination of a number of existing piping systems. However, erosion undoubtedly depends to a large extent on the intensity of force per unit area and, therefore, an examination of the B & M data indicates that, in addition to the momentum criterion, the intensity of force per unit area should be limited to 300 lb per sq ft $V^2 \div (2vg)$.

Examination of additional piping systems by the author indicates that, although these criteria appear to be satisfactory for horizontal runs, erosion has been encountered in elbows at the top of long vertical runs with momentum forces as low as 30 lb and force intensities as low as 150 lb per sq ft. The limits on momentum apply to line sizes in the range from 3 in. to 8 in. Outside this range, the force intensity is used as the primary criterion. In some cases, blank tees have been used in place of elbows and reports indicate limited success.

Severe erosion has occurred in valve body castings and in the run of pipe as a direct result of valve location, particularly for initial pressures above 100 psia and for large pressure differentials across the valve. Much of the possibility of valve body erosion may be obviated by selecting an angle-type valve design in which no direct jet impingement takes place on the valve body casting. This selection has an additional advantage in that the angle valve may be used to replace one 90-deg elbow. If an angle-type valve is used, the energy of the jet issuing from the valve throat will not be partially dissipated on the body casting, and at least 6 or 8 ft of straight pipe should be allowed after the valve, in order that the jet may be expanded and dispersed before encountering a change of direction in the piping. For inlet pressures below 100 psia, "in-line" valves appear to be satisfactory.

Tests by several investigators have established that 1.25-per cent chromium—0.5-per cent molybdenum and higher chrome steels offer a greater resistance to corrosion-erosion (3) than does carbon steel and the use of chrome-moly valve bodies and chrome-moly fittings undoubtedly will result in longer life.

Empirical Flow Formulas

Design of piping to obtain adequate flow capacity is complicated by the fact that the saturated liquid water at the source is potentially a compressible fluid and an enormous increase in volume may take place, due to a small decrease in pressure as the fluid flows down a pipe or through a valve. All homogenous compressible fluids exhibit a maximum in the value of flow per unit area versus pressure drop across an opening, whether the opening is a simple rounded entrance orifice, nozzle, control valve, or the end of a pipe (4).

Pressure existing at the opening under conditions of maximum flow is known as a critical pressure. Saturated steam exhibits a critical pressure ratio of 0.57 to 0.60 over the range from 100 psia to 2,000 psia and for practical use is taken as a fixed value. However, the ratio is much higher for saturated liquid water expanding isentropically through a control device. Critical pressures range from 84 per cent of initial pressure at 400 psia to approximately 95 per cent of initial pressure at 10 psia, as shown on the accompanying curve. Because the critical pressure ratio is high, the variation in the ratio is significant, and it is impossible to select an average value to use and still obtain accurate results. The primary reason that valves and pipes sized by liquid flow criteria or by empirical formulas have failed in service to pass the required flow is the existence of a critical pressure at the throat of the control valve or at the end of the pipe.

Basis for Design Formulas

The design formulas presented in Table I were derived on the basis of a compressible fluid behaving as a uniform mixture at all points in the path of flow. The nature of the uniform

(*Continued on page 102*)

Table II. Test data and calculated results for flow through cascade drain lines of extraction heaters

Line No.	Nominal Pipe Diameter, In.	Flow, Lb/Sec/Sq Ft	Upstream Heater Saturation Pressure, Psia	Downstream Heater Pressure, Psia	End of Line Pressure		Equivalent Length of Line, Ft
					Measured, Psia	Calculated, Psia	
1a	4	206	37.0	8.0	18.2	17.8	58
1b	4	148	29.8	6.5	13.2	12.6	58
1c	4	116	23.9	5.1	10.6	9.7	58
1d	4	82.5	18.2	3.8	6.7	6.8	58
2a	4	286	42.8	10.5	27.4	24.6	49
2b	4	239	38.2	9.0	23.0	20.4	49
2c	4	198	32.5	7.6	18.8	17.1	49
2d	4	157	27.4	6.5	14.5	13.4	49
3	4	251	41.4	8.4	22.0	21.8	90
4	4	260	41	16	22	22.5	100

EXAMPLE:

The drip inlet on the receiver is located 6 ft below the elevation of the drain cooler exit nozzle. Static head = 6 ft = 2.5 psi.

Actual pressure at drain cooler exit = 35 psia.
Temperature at drain cooler exit = 228 F.
Saturation pressure at drain cooler exit = 20 psia.
Receiver pressure = 5 psia.
Flow, lb per hr = 90,000.

$$C = \left[\frac{(196.2 - 194.2)\,(2)\,(20.1)}{(20.0 - 19.3)\,(144)\,(960.1 + 961.3)}\right]^{1/2} \left(\frac{1}{32.2}\right) = (3.59)\,(10^{-3})$$

$$A = \left(\frac{90000}{3600}\right)(3.59)\ (10^{-3})\,(144)$$

= 12.9 sq in. Use 4-in sched. 40 pipe or smaller.

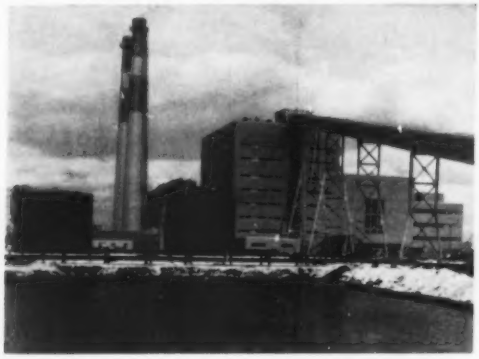
Table III. Example of pipe figuring from formulas of Table I, for Case A, as explained

Initial Saturation Temperature—8th stage heater—361 F
Initial Saturation Pressure —8th stage heater—154.9 psia
Pressure at Valve Inlet —135 psia
Receiver Pressure —12th stage heater—63.2 psia
Flow —17,000 lb per hr
Valve Throat Area —0.56 sq in.

Table IV. Test data and calculated results for a 2-in. regulating valve

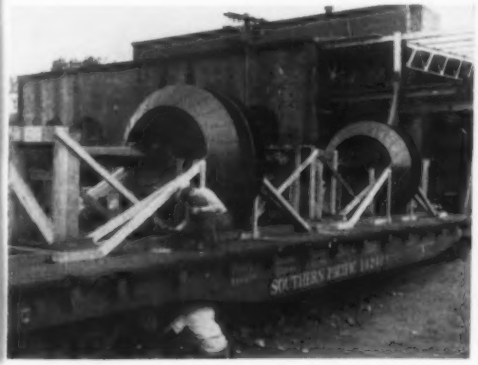
Assumed P_c, Psia	Calculated P_c, Psia	C_1	C_2	W, Calculated $\frac{W}{A}$ Lb/Sec/Sq Ft	W, Measured $\frac{W}{A}$ Lb/Sec/Sq Ft
100	107	− 0.306	0.324_{p1}	1,030	1,210
105	108	− 0.301	0.319_{p1}	1,048	1,210
108	108	− 0.298	0.316_{p1}	1,056	1,210
110	108	− 0.296	0.314_{p1}	1,054	1,210
115	106	− 0.292	0.310_{p1}	1,038	1,210
120	100	− 0.288	0.306_{p1}	983	1,210

Power Engineering

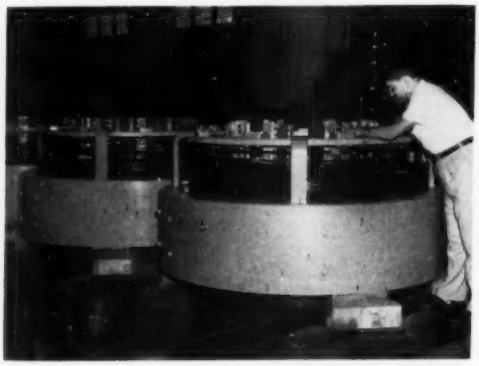


Here's Salem Harbor Station of New England Power Co. at Salem, Mass., as it looks today. First of two 75,000-kw generating units is in operation. Steam conditions are 1450 psi, 1000 F. Latest important large steam power station of New England Power Co. to go into service supplying this important region

Inspecting model of one of two 145,000-kw GE turbine generators, for 2350 psig and 1100 F, now being built for Kearny Station are: (l to r) E. E. Parker of GE, F. P. Fairchild, vice-president and chief engineer, Public Service Electric and Gas Co. and his associate, H. Weisberg, mechanical engineer

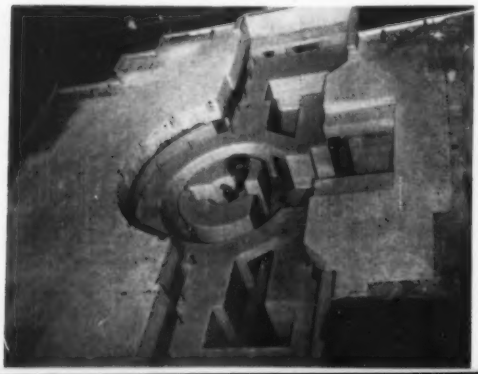


These two induced-draft fan rotors are being shipped from Pratt-Daniel Corp's. plant for installation at new Lecheria plant of Mexican Light and Power Co. Each fan rotor has tip speed of 278 fps, driven at 710 rpm by a 500-hp motor. Workmen making final stowage check on the equipment

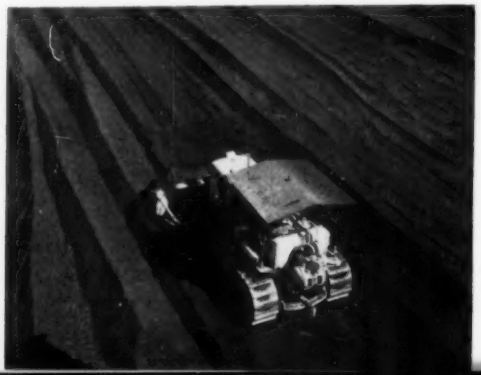


Before shipment to new Kaiser Aluminum & Chemical Corp's. plant at Chalmette, La., these d-c generators are inspected at GE's Schenectady plant. Part of a group of 80 machines, each will be driven by a Nordberg two-cycle gas-fuel radial vertical shaft engine. Each generator is rated at 1290 kw

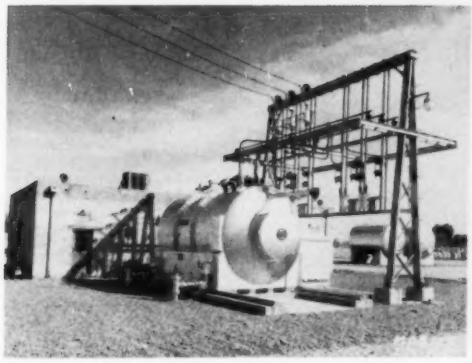
This concrete jig-saw puzzle is foundation for 42-ft boring mill constructed by Consolidated Machine Tool Corp. and erected at GE's Schenectady plant. Driven by a 100-hp d-c motor, mill will machine hydroelectric generator stator frames and upper bearing bracket assemblies. Has overall weight of 1134 t



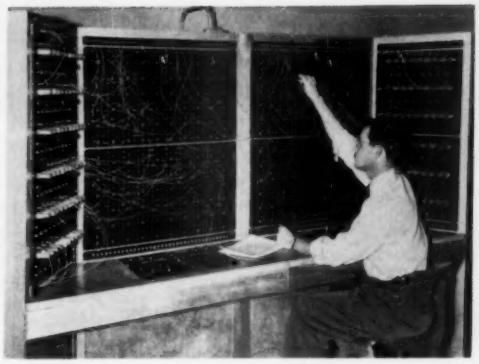
Highly mechanized handling of crushed coal at Plant Yates of Georgia Power Co. helps prevent coal pile fires in its 400,000-ton coal pile. Here a Caterpillar cat bulldozer distributes and compacts coal by the slot-dozing method. Coal pile is 50 ft high, 1000 ft long, 500 ft wide. Three tractors work pile



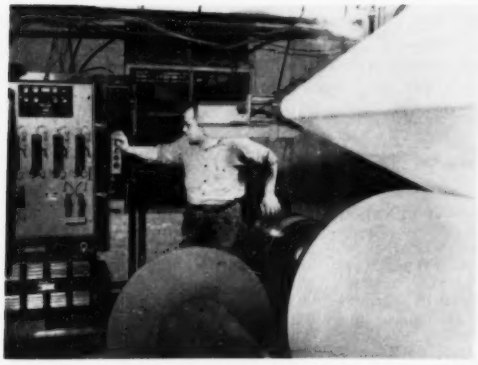
NEWS REEL



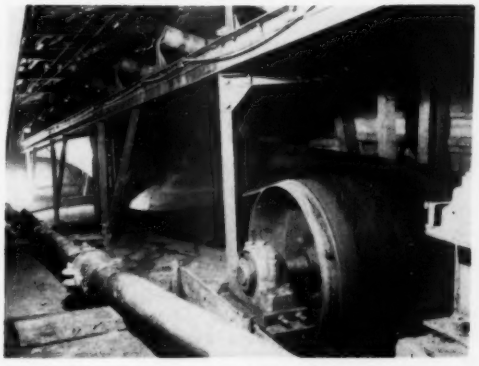
First of new type Elliott hydrogen-cooled synchronous condenser installed on Bureau of Reclamation distribution system at Tucson, Ariz. Rated 20,000 kva at 0.5 psig hydrogen pressure; each end has gas-to-water heat exchanger; cooling fans on rotor; end booms and sole plates and rollers for handling



This calculator is for a GAS distribution system, not an electrical system. Developed and in operation at the Institute of Gas Technology in Chicago, it uses analogies between gas pressures and voltages, flow rates and electric current, to check gas flows, aid in design of new mains and modify existing mains

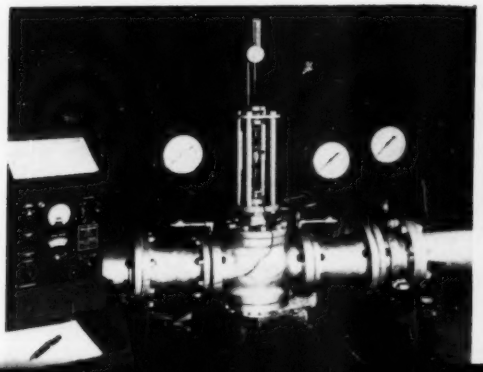


This GE thymotrol drive on a winding reel at Lee Paper Co., Vicksburg, Mich., is claimed to have increased daily production by 25 per cent. Formerly 8 reels per day under manual adjustment; now 10 reels with this automatic electronic control. It holds reel speed constant as roll gets larger

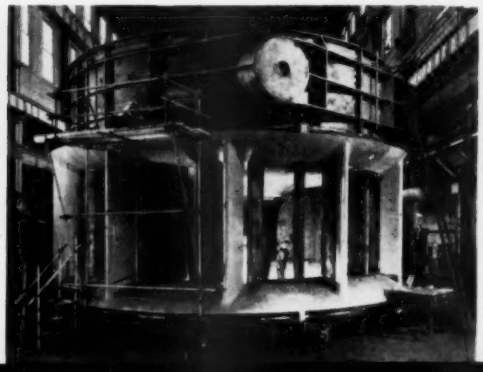


In new turnover belt conveyor system, this 36-in. wide belt twists 180 deg in 36 ft distance. Developed jointly by B. F. Goodrich Co. and Chain Belt Co., it is moving iron ore out of mines and into surface stock pile in freezing weather. Coal-handling systems might also use the idea if self-unloading is needed

To guide in selection of diaphragm motors for automatic control valves, valve stem forces were determined recently by means of Baldwin SR-4 resistance wire strain gages, in an investigation carried out by Mason-Nielan. Force on valve stem throughout the stroke varies more than is commonly realized



Erecting shop assembly of Kaplan propeller-type hydraulic turbine in Allis-Chalmers shop for Unit No. 5 of TVA's Pickwick Landing plant. Unit rated at 55,000 hp, 43 ft head, 81.8 rpm. Visible are pit liner above stay ring; wicket gates open; inner head cover supporting bearing. Unit is one of largest



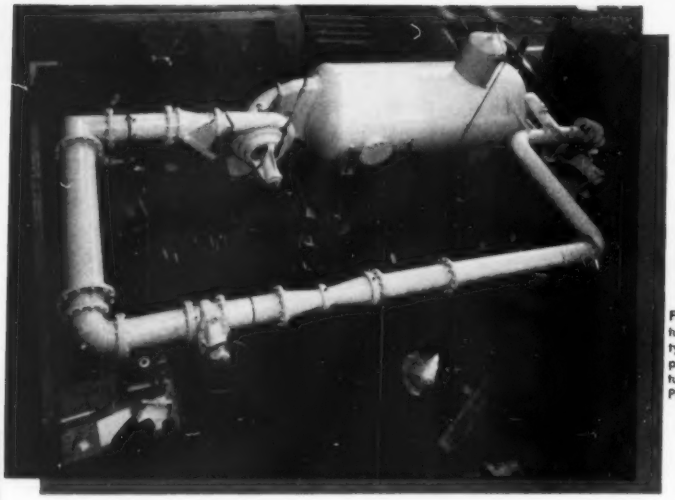


Fig. 1. Complete assembly of model test reversible turbine equipment in hydraulic laboratory. Prototype rating: 370 cfs, 240 ft head, 300 rpm as a pump; 12,000 hp, 290 ft head, 257 rpm as a turbine. For U. S. Bureau of Reclamation, Flatiron Power and Pumping Plant. Allis-Chalmers photo

Reversible Pump Turbines Are Different

They must be designed and built on different basis from conventional hydraulic turbines. . . . Reversible pump turbines operate either as pumps or turbines. . . . As pump, driven by low-value off-peak electric power, unit pumps water to storage, whence it flows back through same unit to generate high-value peak-load electric power. . . . Difference between pump and turbine efficiencies. . . . Possibilities of 2-speed operation. . . . Why wicket gates? . . . Start and stop

By F. E. JASKI, Hydraulic Section, Allis-Chalmers Mfg. Co.

REVERSIBLE pump turbines are hydraulic turbines designed so they can be used for generating power, revolving in one direction; or for pumping water, revolving in the opposite direction. In the first instance, the generator is driven by the turbine and supplies power to the system. In the second instance, the generator acts as a motor, taking power from the system to drive the pump for pumping the water.

Design Differences

This type of power is known as pumped storage power. For turbine operation, water flows from a storage reservoir through the turbine to a lower reservoir or suction pool. For pumping, the water is pumped by the same unit from the suction pool and returned to the storage reservoir, where it is available for another cycle of power generation. The pumping is done during periods of low power demand, when off-peak power used for pumping is obtained at low cost. The turbine operation supplies power for peak loads when it is worth more per kilowatt-hour.

A reversible turbine * is specially designed for this type of operation so it will operate at high efficiency either as a turbine or as a centrifugal pump. A conventional Francis turbine is not suited for this kind of service. The buckets in a Francis runner are designed as nozzles and usually form short water channels that are adequate for developing power. However, the same runner, if used for pumping, will not develop sufficient head if used at the same rpm in both directions, and would have to run at much higher rpm to pump against the same static head that is used for turbine operation.

The Francis runner buckets, while adequate for developing power at high efficiency, will not be very efficient for pumping. A Francis turbine used for pumping would require a great deal more submergence under the suction pool level than a reversible turbine. The amount of submergence is governed by the flow through the runner when used for pumping. The flow through a Francis runner when pumping will not be as smooth as in a reversible turbine and will be turbulent, resulting in rough operation.

Reversible turbines, if designed correctly, will develop high efficiency whether operating as turbines or as pumps running at the same rpm. Actually, the rpm required for maximum efficiency as a pump is a little higher than the rpm for maximum efficiency as a turbine. However, these can be brought fairly close together so a suitable rpm can be selected that will give high efficiency for both. If it is desired to obtain the maximum efficiency for both pumping and turbine operation, then we must use two speeds — one for pumping and a lower speed for turbine operation. It is possible to do this by using an induction generator (motor). With the proper switching arrangement and pole changing combination, the unit can be run as a motor at higher speed and as a generator at lower speed.

Why 2-Speed Operation?

There is considerable advantage in operating at two speeds with certain classes or types of reversible turbines. This is particularly so in the higher head range, say from 150 ft up to 1000 ft head. In this head range, the turbine will develop more power when operated at a lower speed than if used at the same speed as for pumping. There will also be some gain in efficiency. This is shown by a comparison of Figs. 2 and 3.

* See POWER ENGINEERING, July, 1950, New Pump Turbine Stimulates Interest in Pumped Storage Development; *Ibid.*, October 1951, Pumped Storage Hydroelectric Power, by Charles H. Spink.

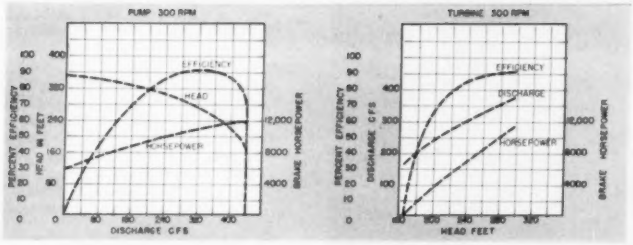


Fig. 2. Separate performance curves of reversible turbine, showing differences at 300 rpm for pump and turbine operation. Note differences in shapes of the efficiency and horsepower curves

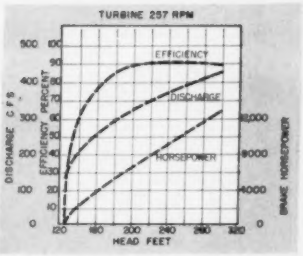


Fig. 3. Turbine performance of same unit as Fig. 2 for operation at 257 rpm and higher efficiency

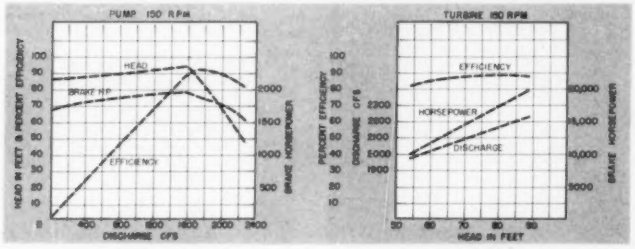


Fig. 4. Separate performance curves of reversible turbine showing differences at 150 rpm for pump and turbine operation. Note differences in shapes of the efficiency and horsepower curves

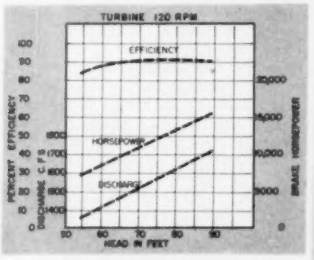


Fig. 5. Turbine performance of same unit as Fig. 3, for operation at 120 rpm and lower horsepower

Figure 2 shows performance curves for a reversible turbine for 300 ft head running at 300 rpm for turbine operation and for pumping at 300 rpm. Figure 3 shows the performance curves for the same unit if operated at 257 rpm for turbine operation. The horsepower and efficiency are both higher at 257 rpm than at 300 rpm. The generator for two-speed operation would cost more than for a single speed, but the increased output would soon pay for the additional cost.

Relative Efficiencies

At heads below 150 ft, if we use a lower speed for the turbine than we do for pumping, we will obtain higher efficiency but the power output will be lower. For example, Fig. 4 shows performance curves for a reversible turbine with 89 ft head running at 150 rpm for turbine operation and for pumping at 150 rpm. Figure 5 shows performance curves for the same unit operated at 120 rpm for turbine operation. In the second case we obtain somewhat higher efficiency but the horsepower is lower. For pumped storage power, the higher horsepower output at one speed is worth more than the higher efficiency at two speeds.

How Wicket Gates Are Used

Reversible turbines can be furnished with or without movable wicket gates. Advantage of wicket gates for pumping is that they produce a broader efficiency curve showing high efficiency over a large range of discharge. This is obtained by gradually closing the gates as the head increases and discharge gets smaller. Wicket gates balance the side thrust on the runner and help to prevent a deflection of the shaft which might cause rubbing at the seal rings.

Another consideration is that some pumps require less power at shut-off (zero discharge) than at rated discharge; in this case, the wicket gates can be closed to stop flow and the pump started at the lower load. If the pump is started unwatered with gates closed, the horsepower for starting is only a small fraction of the full load power. Of course, the pump could also have a butterfly valve or rotary shut-off valve instead of wicket gates, but the broad efficiency curve could only be obtained with wicket gates.

Also, if the water is to be depressed for starting we would only need to evacuate that part inside the wicket gates, while with the butterfly valve we would also have to unwater the casing up to the valve, which would take a larger volume of air. For starting up the turbine, the wicket gates would give a finer control of the unit when bringing it up to speed than a butterfly valve. If load was lost suddenly, the wicket gates would give smoother control for shutting the unit down than a butterfly valve.

Starting Reversible Turbine

For starting a reversible turbine for pumping, several methods may be used:

1. The pump motor can be tied in directly to a generator of another turbine and the two machines brought up to speed together. It can then be switched to take power from the system or may be left tied in to its particular turbine and generator.

2. The pump can be unwatered by compressed air so the water is below the runner. It will then require only a fraction of full load power for starting and, after it is up to speed, the air is released and the pump picks up the water and operates at its normal load.

3. With a large transmission system, the pump motor can be started directly from the line and the power input to the motor will not cause a serious disturbance on the system. Many large pumps are started up in this manner and are operating very satisfactorily.

If Pump Power Is Lost

If power to the pump motor is suddenly lost, the flow up the pipe line will stop and then flow down the pipe causing the unit to run in the opposite direction. It may then reach its maximum overspeed with no load (runaway speed). The maximum overspeed with no load for a reversible turbine is usually lower than for a conventional Francis turbine and both the turbine and generator are designed to operate safely at this speed, so no parts will be overstressed before the water can be shut off and the unit shut down. In most cases, proper interlocks will start closing the wicket gates or shut-off valve when the power to the motor is lost and the unit can be shut down before its maximum overspeed is reached.

Reversible turbines can be obtained for heads up to 1000 ft and as low as 40 to 50 ft, and for outputs as high as 100,000 hp.

Fig. 1—Left. In surveying the electrical distribution system, we measure all the load everywhere

Fig. 2—Below. When they are this size, it pays to learn who might be shirking or "hogging" the job

Fig. 3—Right. This is one way of getting power into tight places on some types of machines

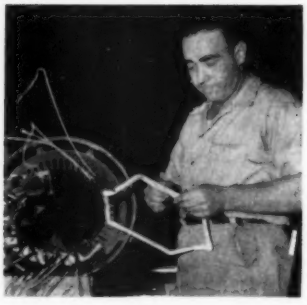


Fig. 4—Farthest Right. Rewinding motors for higher-voltage operation saves copper and power

Your Electrical Distribution System—Asset or Liability?

By **PAUL C. ZIEMKE,** Oak Ridge, Tenn.

WHEN YOU take stock of your industrial power facilities each year, do you have misgivings as you regard the vital link in your production line — the electrical distribution system? Or do you know just how good the investment is, so that your plant will not be in the business doldrums if expensive equipment failures occur to ruin your production curve? Is the system sound from the viewpoint of continuous plant operation? Or will the power engineer's hair change from gray to white as he struggles with an unscheduled breakdown that has your plant's customers shouting at you because of the delay and has your raw materials stacking sky high, while your shipping room is as empty as Mother Hubbard's cupboard? — and that really is empty!

How do you find out if it's asset or a liability? . . . By making a complete survey of distribution system, right out to the last lamp in the gateman's shelter . . . (In industrial plant, of course, but utilities can use it, too) . . . Important for power engineers because system load is what the generators have to carry . . . You must check all circuits for load-carrying capacity, survey system voltages, test insulations, check power factor and motor sizes . . . This is the first of three articles telling you in 1–2–3, step-by-step fashion just how to do it . . . The present article goes over the general survey method . . . Another will show you exactly what measuring and test instruments you must have for a complete survey and how to use them; a third will show you how to raise power factor

In a previous article (Good Electrical Systems Make Industrial Profits, POWER ENGINEERING, March 1951) we dealt at length with all the baneful ills of an outmoded system. In this present article we shall cover another phase of electrical engineering, the advantages of power adequacy, with a series of "one-two-three" instructions on how to organize and conduct an electrical distribution survey.

Diagnosing Electrical System Ills

Rarely does a plant fail to outgrow its initial facilities, unless it be a mining operation (where all too often the recoverable quantity of ore was overestimated and depletion occurred before the machinery had outgrown its planned period of usefulness). Contrariwise, practically all manufacturing plants eventually find themselves bursting at the seams, in more ways than one.

That is a healthy situation and is to be hoped for, if profits are to continue to increase from year to year. Keeping tabs on the growth, in order to plan effectively for expanding system changes, is not too difficult a task if tackled early enough. Like the human medical check-up, it must be done at planned intervals lest certain unknowns suddenly flare up in hectic trouble.

Survey Scope and Objective

A thorough survey will include all the system installations from substation to the last receptacle in the watchman's shelter where he eats his noonday sandwich. When insulation values are checked as part of the survey, many otherwise hidden weaknesses will be disclosed. Steps can be taken to correct these in due time, before a major eruption in raceway or splice box brings sudden notice of a serious insulation breakdown. There is also the opportunity to check on the many mechanical features that have a direct bearing on the welfare of the power supply. When found, like some of the electrical troubles, repairs can be postponed for normal non-operating periods, if a complete case history is made on the occasion of the survey.

Outlined here are the principal features we wish to cover in our survey:

a. Sufficient size of copper conductors to power present and future needs.
b. Proper insulation on resistors to eliminate fire hazards.
c. Short circuit and overload protection on all feeders and circuits.
d. Properly constructed ground system for all apparatus.
e. Safety devices in the form of guards, lockout devices and shields.
f. Lightning arrestors and power factor correction capacitors.
g. Insulation values on all prime circuits.
h. Moisture conditions in areas where condensation occurs.
i. Temperature values, operating and ambient, within safe limits for various insulations.
j. Mechanical protection for all conductors, plus secure fastening.
k. Accumulations of explosive dusts, corrosive acids or lints.
l. Improper application of electrical apparatus.
m. Loose, corroded, bent or rusted switch or fuse contacts.

Our analysis will include such features as these:

1. Determine actual and maximum load-carrying capacity of prime service, feeders, branch feeders, transformers and distribution panels, plus overload protection devices.
2. Survey of system voltage and fluctuating loads in various branches.
3. Tests of insulation by megger method.
4. Power factor survey to reduce wattless current and heating of conductors.
5. Check motor sizes for underloaded motors, to bring system power factor up to highest value.

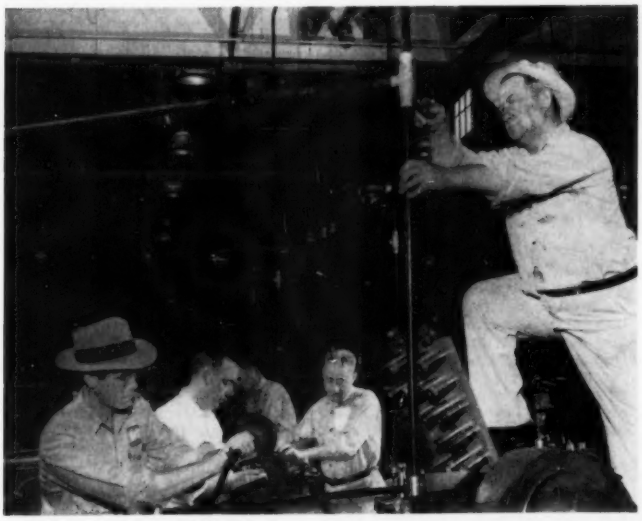


Fig. 5. General overhaul of circuits; use of synthetic insulation permits proper upgrading of wire size

Voltage Drops

In alternating currents there is always a voltage drop due to self-induction. The magnetic field that always surrounds a conductor carrying electric current is continually changing and reversing as the instantaneous current changes and reverses twice in each cycle. This change in the magnetic field induces a voltage in the conductor in such a direction as to oppose the change of current flow. This opposition to the change in current flow is expressed as the reactance. The reactance voltage drop is given by the equation: $E = x_1$, where E is voltage drop and x_1 the reactance.

In all alternating current circuits, both resistance drop and reactance drop are present in varying proportion. Calculation of voltage drop to take into account both resistance and reactance drop is more complicated than the simple calculation by Ohm's law, because the two drops do not add directly but at right angles, as the two legs of a right triangle relate to the hypotenuse. That is, if z is the impedance, then $z = \sqrt{r^2 + x^2}$ where r is resistance drop and x is reactance drop. If z is known for the complete circuit under consideration, the total voltage or impedance voltage drop is $E = z_1$.

Optimum Voltage Needed

Section 2202 of the Code reads that the voltage drop of the feeders should not be more than 3 per cent for power loads or 1 per cent for lighting or combined lighting and power loads. This requirement is aimed at a goal of adequacy rather

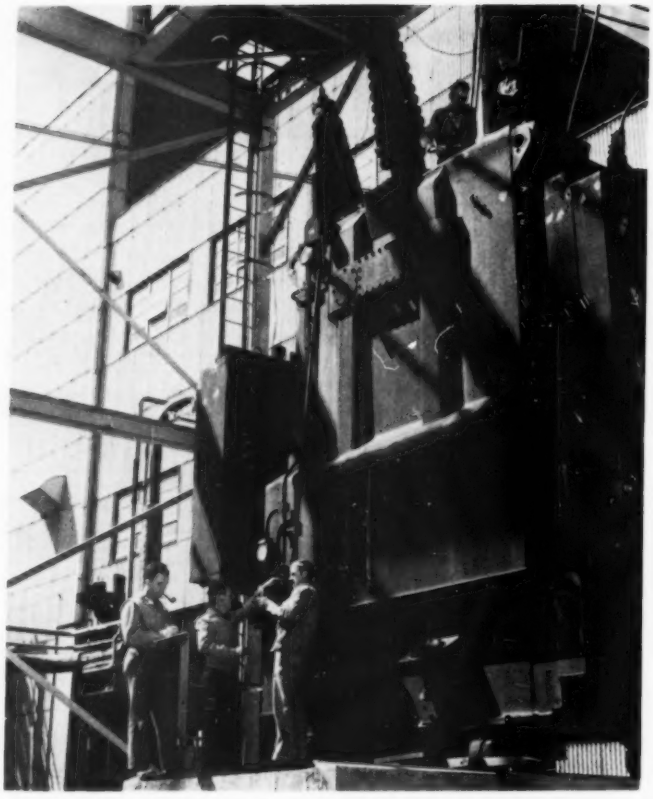


Fig. 6. The Goliaths get an annual oil, gas and insulation check as part of the regular system survey

than from the view of a hazard, although a fire hazard does enter into the picture in this manner:—a motor driving a given load will require about the same power from the line whether the voltage is normal or lower than normal.

Load Survey Technique

Electrical engineers wax eloquent about the best starting point for the load survey. It matters little, however, whether we start from the substation or "reverse the field" and begin at the remote heater outlet in the gateman's shack. The emphasis must be on the thoroughness with which the work is done, and the factual keeping of the records developed. There is a choice of methods: in some cases, you may wish to work the route on a building or department basis; or, it may be advantageous to stick to a straight circuit routine, even though that circuit may serve two buildings or departments.

Of great help is the survey outline prescribed by the National Electrical Contractors Association, 1200 18th St., Washington 6, D. C., which has spaces for the most important data you may wish to log. All other data developed can be entered on extra ruled sheets. These should log the data on sub-feeders, branch circuits, distribution panels and any unusual facts that may bear weight in the final load survey.

Motor data should be gathered on individual cards. Develop field sketches or any alterations or additions that do not appear on the original building wire plants. You may then bring the plans up to date and commence improvement designs from there.

Determine the Connected Load

The load conditions on the system will bring out the vital information we need to determine the degree of unbalance or overload, and, what is also important, underloaded circuits that are "loafing". It is often quite revealing to go over an installation with the proverbial fine-tooth comb and find some rather unorthodox connections and taps that confound the situation considerably. Methods of determining these things will be covered in a later article.

If the voltage is lower than normal, the current will be higher than normal to maintain the same power. This tendency, while small, does overload the circuit.

The ASA and NEMA standards indicate that motors will operate successfully if they suffer voltage fluctuations that vary from 10 per cent above to 10 per cent below normal value. Here is the catch though: Their performance will not be the same as at rated voltage. At 10 per cent below the voltage the characteristics of an induction motor will be affected unfavorably in the following ways:

a. Starting and pullout torque will average 80 per cent of normal.

b. The temperature rise of the motor is noticeable and there will be decreased efficiency and increased power factor.

c. The slip will increase roughly about 21 per cent, which means that a typical motor having full-load speed of 1720 rpm will run at 1683 rpm.

Lighting and Heating Loads

While incandescent lighting circuits have a lower current drain at low voltage they also deliver correspondingly less light for the power used. It is admitted that the lamps last longer, but certainly at the expense of seriously reduced lumen output. All too frequently, more lamps are turned on to overcome the handicap of low voltage. Or the sockets are filled with bulbs of larger size, which then draw more current. Thus we are back where we started, with some trouble added.

In the case of heating loads, less power is consumed with voltage below normal, but at the cost of lowered heat output and resulting loss of production. At 90 per cent of the normal voltage the heat produced will be only 81 per cent of normal. Where low voltages are permitted, the copper (I^2R) loss in the circuits is greater. In view of this fact and the greater savings in copper made possible by the installation of power centers near the load and by utilizing longer high-voltage primary lines and step-down transformers, it is wise to adopt this idea when considering new wiring plans. The long runs of distribution circuits are then placed in the primary side of the load, with a corresponding shortening of the low-voltage runs requiring the installation of heavy copper. In other words, the high-current, high-copper circuits are shortened and the high-voltage, light-copper lines are lengthened. The Code permits such primary lines to operate at values up to 15,000 v.

Other baneful effects of low voltage become apparent as we realize that:

At voltages 70 per cent of normal, fully loaded induction motors are at the stalling point.

At voltages 65 per cent of normal, contactors begin to drop out.

At voltages 60 per cent of normal, 0.8 pf, synchronous motors under full load may pull out of step.

At voltages 75 per cent of normal, unity pf synchronous motors under load may pull out of step.

At voltages 85 per cent of normal, fluorescent lamps flicker badly or stay out.

New Slants on SMOKE

Most industrial cities have instituted smoke control programs in an effort to reduce smoke and fly ash nuisance. But how realistic are they? The author, pulling no punches, offers some convincing reasons why some modification of current practice by both industry and community would be desirable. A merit rating system, better understanding by smoke departments, better overfire air, and conscientious combustion practice by industry—these would help

By PAUL A. DOBBS

Fig. 1. Each stack is discharging same amount of flue gas (50,000 cfm) and same amount of smoke. Which stack do you think gets the smoke notice?

OBLIGATION of management to have good combustion practice in its boiler rooms has been presented in many recent article . Large and small plants have this obligation, and sufficient information has been published so that no plant need lack for action in this direction.

Progressive communities have instituted smoke control programs which seek to minimize this boiler room nuisance. One feature of the control programs is the power of the smoke department to judge the violation and to assess fines through the court system of the local area. Greater power than is at first apparent, its strength lies more in a psychological vein than in direct action. Most men who are associated with industrial power plants and steam plants will agree, although some will dissent, of course, that the average stationary engineer, fireman or boiler operator has more fear of getting a smoke notice than of poor combustion practice.

As a result of fear reaction on the part of the average operator, there is a tremendous economic loss due to poor combustion practices; and this article is presented in the hope that others will write about this same phase of the program.

New Stacks vs Old

Perhaps newer stack design is responsible for some smoke notices that would not be issued to owners of large diameter chimneys. Smoke is measured at the top of the stack at the point of emission, because it is thickest there and no other influences enter in to make it difficult to judge the amount. Modern stacks are small diameter and have a jet action which directs small particle emission high into the air with wide distribution so that no area in the community suffers unduly. Small diamater stacks concentrate the smoke column into greater density than a large stack. With equal loads, smoke issuing from the large diameter stack appears negligible compared to the jet stack of $\frac{1}{10}$ the area.

For instance, assume 50,000 lb per hr steam load, a large chimney 12 ft in diameter and 200 ft high, and a small jet stack 42-in. in diameter and 150 ft high. To make the comparison more forceful, let's imagine that the jet stack is only 6-in. in diameter. It will be appreciated that now the smoke from the small stack will be a solid pencil of carbon of maximum density and the owner will surely get a *smoke notice* — but the owner of the large diameter chimney is still a smoke saint, with the *same amount of smoke*. Of course, this will be criticized as an untrue example and so it is; but it carries, albeit, a ridiculous conclusion, the force of the idea that diameter is a major dimension in the smoke picture. This is not a new presentation of that idea in any sense but it is amazing how little it is considered in application of smoke control. Modern jet stacks are penalized unduly.

Merit Ratings for Plants

Another phase of the control program should include a merit rating. At present a stack can smoke continuously, at say 15 per cent Ringlemann, without a smoke notice. Another plant which has a perfect stack almost continuously but for perhaps 1 hr per month, and that hour spread over 3 or 4 min periods, will get a smoke notice even though the emission per month is probably less than 1/10,000 of the continuously smoking stack. A plant which can earn a merit rating should have permission to smoke for a total of 1 hr per month without penalty.

Two sequences must be separately considered here. Some way should be found for allowing a usually clear stack some leeway for unusual conditions. Such a stack is the result of constant effort on the part of the operating crew and the owner, who provided equipment enabling the crew to attain such a result. When combustion conditions are controlled closely it is to be expected that some momentary sharp load change, or minor adjustment, can bring equally momentary difficulty. Smoke will appear immediately because combustion conditions are being held to close tolerances. At present the operating crew which normally has a clear stack is subject to all the pressure the smoke department directs toward all violators, careless or not careless.

Second factor in the apparent clear stack versus smoke consolidating jet stack is smoke dilution by excess air. Excess air jets are installed at the insistence of smoke departments to decrease smoke and often they are effective. However, the average operator carries far too much excess air in an effort to thin out or dilute the smoke to an acceptable value. Because of too much air chilling the furnace and the tip ends of the flame, this practice results in making smoke. Most men who visit boiler rooms where flow recorders are used

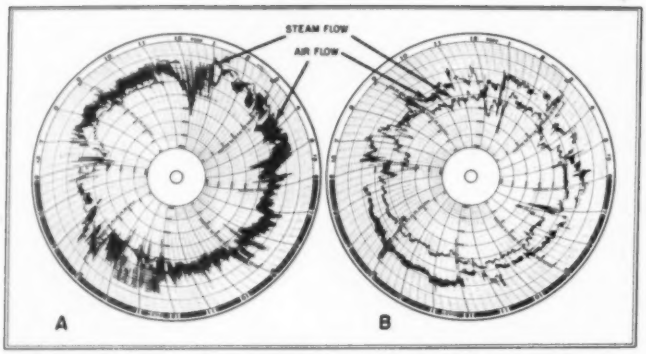


Fig. 2. Two typical steam-flow-air-flow charts from a boiler plant. A–chart showing air flow close to steam flow. B–chart showing air flow and steam flow lines too far apart, indicating too much excess air, used in attempt to prevent smoke. We need excess air but we must learn to use it in the right way

will agree that seldom is the air flow pen on the same line as the steam flow pen. See Fig. 2. When it is realized that such combustion indicators where both pens are tracking one line are normally set for 35 to 40 per cent excess air, one will realize how much excess air is being put through the furnace when the air flow pen is ½ or more in. above the steam flow line. Excess air in such amounts is used because the operator is afraid of getting a smoke notice if he operates closer to good combustion. He takes the expensive way out for his employer. Indeed, his employer often insists that the engineer get no more smoke notices and so is partly responsible for the uneconomical operation.

Another factor which has greater influence than is usually appreciated is sky shine behind the smoke column. Refraction in the heat waves causes a smoke column to have entirely different appearances on light or dark sky colors, such as on sunny or cloudy days. Position of the observer, on the same or opposite sides as the sun, is also an important factor.

Inefficiency Losses Mount

Power the smoke departments could exert for good is often focused as fear in the operators' minds. The financial loss due to too much excess air is staggering. In my judgment it would amount to not less than $500 per month and possibly as high as $1200 per month for an average load of 50,000 lb of steam per hr. The difference is due to variations in forced, overfire and induced draft, or excess natural draft.

An average plant that hires just average combustion control men (stationary engineers) gets just what it pays for. The average stationary engineer is not well informed on the items of his work that require mental vision. He sees cast iron and coal but seldom looks through the cast iron and coal to *see* what it could mean to him. In few places in an industrial plant is the possibility of savings as great as in the boiler room, yet it is the most often neglected. Few men understand that a penny saved is worth far more than a penny earned: one is added to the net profits, the other to gross profits out of which come all expenses. Savings in the boiler room are just as effective as elsewhere, and often easiest to attain with properly paid help who can realize these savings for an employer.

It would be surprising if more than 10 per cent of the small-to-medium plants, or more than 25 per cent of the large industrial plants, employ good combustion practices. Fair is not being considered; good is what the employer is entitled to, and should receive. If this depressing estimate is within the target area at all, monetary loss in a large metropolitan area must be millions of dollars per year.

Dust and More Dust

There is no need to make dust in order to decrease smoke. In fact good combustion practices automatically decrease dust and dirt to negligible amounts. Smoke dilution by excess air to avoid smoke department notices automatically increases dust and dirt emission to major values. So the same poor operational procedures that cause monetary loss to employers also cost the community. The reason for this is easy to understand. Excess air requires that velocities through boiler passes be too great, more than the boiler designer calculated, and sufficient to carry fine dust particles in suspension. This dust is partly combustible, and some is ash particles which strike cool boiler surfaces and condense or stick and thereby propagate the condition by causing higher velocities due to restricted gas passages. So the boiler quickly becomes dirty, stack temperatures rise, efficiency drops, maintenance costs increase. With good operation, furnace pressure (or draft) is held to the minimum required for safe operating, just enough draft is held to avoid burning one's face when a fire door is opened. If observation ports were properly used, most boiler doors could be kept closed instead of being used for seeing. A large boiler door cannot be opened for less than 10 to 20 cents per look, depending upon the time the door is held open.

Overfire Air Needed

In Lloyd Stowe's book, The Art of Burning Coal, probably the finest instruction ever written on the subject, mention is made that approximately ⅔ of the air for combustion should come through the grate and ⅓ through the overfire air passages. This overfire air should introduce the turbulence we all know we want and do so little to get. With this relation of air, no excessive draft, clean tubes fireside and waterside, the engineer can be proud of his operation, the employer of his investment, and the smoke department of their intelligent cooperation.

It is *not* that way now.

DEMINERALIZED FEEDWATER FOR GULF STATES' NEW UNITS

SUPPLYING exhaust steam directly to process makes it possible to avoid heat loss in condensing water. This is accomplished by using high-pressure turbines exhausting directly to the process headers.

This is the principle behind the installation of the water demineralization and silica absorbing plant for the treatment of boiler feed make-up at Gulf States Utilities, Baton Rouge, La.

In 1929 Gulf States designed a plant to produce power with high-pressure turbines, and pioneered in the sale of exhaust steam to industry at desired pressures. Due to the large make-up requirements, the incoming raw water supply was softened with Permutit zeolites for the protection of the boilers operating at 640 psi.

Capacity of the plant was 2,000 gpm. Later, two additional softeners were installed and subsequently the capacity was further increased.

Recently they decided to make additional steam available at higher pressures and also produce lower-cost electrical energy to take care of increased customer demands.

Now in the construction stage, under the direction of Stone & Webster Engineering Corp., are these new facilities. For this expansion, they will erect 1,800-psi boilers and install a push-button automatic 3,500-gpm. Permutit demineralizing plant, for make-up supply required by the new boilers.

Equipment consists of 8 cation exchangers; 8 anion exchangers and 2 high-vacuum deaerators. These cation exchangers will remove the carbonates of calcium, magnesium and sodium from the water while the anion units will remove the sulphuric and hydrochloric acids formed by the cation exchangers. The deaerators will receive water from the cation exchangers for removal of carbon dioxide and oxygen gases. The result is expected to be an effluent equivalent to distilled water.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

DEAN OF BOILERS

MANY OLD TIMERS, still active in the field, can remember when the predominant industrial power plant consisted of a battery of hand-fired hrt boilers and one or more reciprocating steam engines, the steam being generated at approximately 100 psig. Yet despite all the progress that has been made in the past 50 years in the development of the watertube boiler, and of other types of firetube units, such as the 2, 3 and 4 pass types, a very large number of hrt boilers are still in operation and giving good service. In some cases these are new boilers, installed within the last 10 years or so, in other cases they are older ones kept in good condition. For all those and many other reasons, the author of the following article calls the hrt the Dean of Boilers.

Time was when hrt boilers were set right down within 3 or 4 ft of grates. Nowadays, however, something has been learned about furnace design and when proper combustion space is provided for an hrt boiler, together with some form of stoker, oil burner or gas burner to replace the man with the scoop, and when the load does not swing either violently or very much, it is possible to get very good economy with the hrt boiler.

Another way of getting the best out of hrt boilers under modern conditions is to equip them with proper instruments and automatic controls. Hand firing is, of course, passing out of the picture so fast now that we cannot remember when we have seen a hand-fired boiler. With simple but adequate instrument and control devices, the full potentialities of the hrt boiler, with a proper furnace setting, can be realized and steam can be produced with considerable economy.

In these days of high labor cost and scarcity of good firemen in certain industries, this is extremely important.

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HRT Boiler, Too, Needs Proper Instruments and Controls

By **DENARD L. GUSLER,** Consulting Engineer

Dean of small boilers is the good old horizontal return tubular . . . Eye-teeth-cutters for all old-timers; still used in many boiler plants . . . But hand firing is now passé; a water glass and a steam gage no longer are enough to guide the operator . . . Various types of stokers for the hrt boiler will save much fuel . . . Also, if boiler efficiency is low, and even if only relatively small amounts of fuel burned, still the fuel waste and extra cost can add up fast . . . To prevent it, we must give the hrt boiler operator some simple but adequate automatic controls and instruments to help him . . . Here an engineer with much experience in operating small industrial boiler plants tells you what these helps are and how to use them effectively

THE HORIZONTAL return tubular (hrt) boiler, like the one shown in Fig. 1, might well be called the dean of small boilers. Because of its simplicity and widespread use in the small industrial power plant, it was selected to illustrate what can be done with proper instruments and control. It should be equipped with the instruments shown in Fig. 1—the essential ones for satisfactory operation. These will provide the engineer with the data he needs to operate at maximum efficiency.

The steam pressure meter, steam flow meter, CO_2 or combustion meter and flue gas temperature recorder operate best when used as a team. Working together, they tell the engineer all he needs to know about performance at any given time. To illustrate how this works in practice, several charts are shown (Figs. 2, 3, 4) which were picked at random. A valuable asset of the charts is that they provide a history of performance. But more important here, by looking first at the information they provide, and thinking of how it can be used to improve operation, you see why these particular instruments are the essential ones.

What the Charts Tell

Charts of Fig. 2 indicate a full day's satisfactory operation. The steam pressure curve indicates the pressure began to rise on the boiler at 5 a.m. and it went on the line at 6 a.m. Pressure remained constant until 4 p.m. when the boiler was shut down and the flues blown. This is indicated by the sharp dip and rise in pressure at 4:15. From the steam flow we see the boiler began to generate steam at 6:30 a.m. with full load gradually coming on by 7 a.m. The boiler was shut down at 12 noon but remained on the line. Load was resumed again at 1 p.m. and the boiler shut down again at 4 p.m.

The CO_2 chart shows excellent combustion efficiency throughout the day's operation. The fuel air ratio on this particular boiler was set to maintain 14 to 15 per cent CO_2, resulting in a clean fire and clear stack. From the flue gas temperature record we note the boiler sooted slightly, for there was a gradual rise in temperature. Blowing the flues at 4:15 remedied this condition.

A Not-So-Good Day

Chart segments of Fig. 3 cover a period of operation on another day from 10 a.m. to 2 p.m. It is easily seen that combustion was poor. The CO_2 chart indicates too little air. The stack was undoubtedly smoking very heavily. The low flue gas temperature also indicates an inadequate supply of air. The erratic swings in the flow-meter record between 12 noon and 1 p.m. show the automatic fuel feed was being reset. Each swing indicates where a reduction in fuel was made and then checked to see if the proper value was achieved. It will be noted proper CO_2 was again established at 1 p.m. and normal operation resumed. The flue gas temperature leveled out at a high value because the boiler had sooted heavily during the period of sooty operation.

When Maximum Load Went On

Figure 4 is a set of charts for still another day. On the steam flow chart, a maximum load went on the boiler shortly after 8 a.m. There was also a steam pressure drop. This load resulted from complete loss of a boiler on the line. The other boiler was restored to service in less than five minutes. The flow meter swings until 8 a.m. are due to swings in the feedwater. The CO_2 meter shows the sudden loading of a boiler at 8 a.m. resulted in a very poor CO_2 ratio. The furnace was being crowded momentarily beyond its capacity to burn fuel and a very smoky stack resulted. The same trouble almost occurred again at 10 a.m. but was apparently the failure of only one stoker.

Operation throughout the remainder of the day was satisfactory. The CO_2 chart for the day indicates the fuel-air ratio was not exactly right. The fuel feed should have been increased slightly in comparison to the air entering the furnace. The stack would be clear under the conditions shown but some heat would be wasted in the flue gases. These are conditions the engineer will not know about without the combustion meter or a portable Orsat.

Boiler Elements

Schematic diagram, Fig. 5, shows the minimum essential parts of any boiler: furnace, steam generating space, outlet flue. Leaving the furnace are several invisible variables, namely, CO_2, CO and nitrogen. Also leaving the flue outlet are visible variables such as carbon and fly-ash. Unburned carbon can cause a very black stack and represents a fuel waste in proportion to the color of the stack. The percentage of CO_2 and CO will depend on the proportion of fuel and air entering the fur-

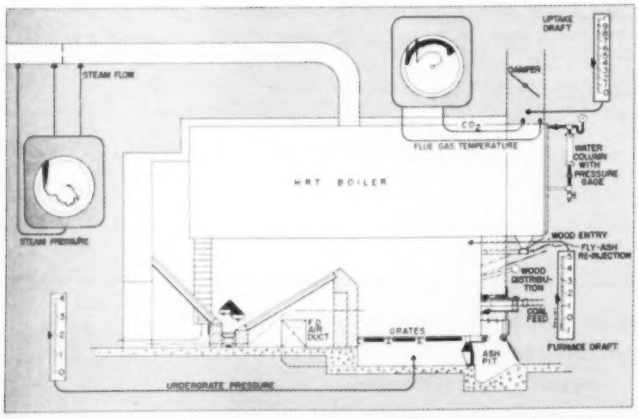


Fig. 1. Schematic diagram of horizontal return tubular boiler showing essential parts and basic instrumentation needed for economical operation. This particular boiler is fired with coal and wood waste

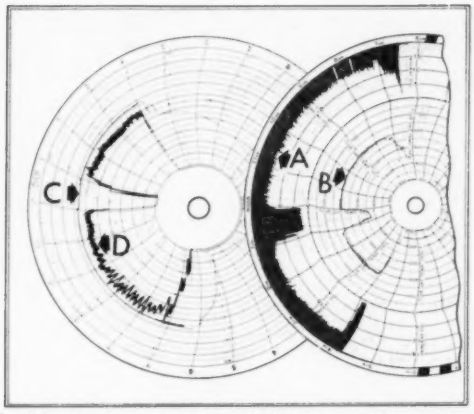


Fig. 2. Recorder charts for a satisfactory day's operation showing: A — CO_2, B — Flue Gas Temperature, C — Steam Pressure Line, D — Steam Flow Line

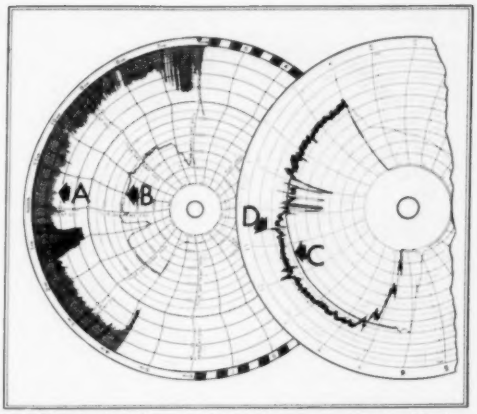


Fig. 3. Recorder charts showing indication of poor combustion: A — CO_2, B — Flue Gas Temperature, C — Steam Pressure Line, D — Steam Flow Line

nace and on the combustion efficiency.

Combustion Control

Also shown, Fig. 5, are the mechanical essentials of a typical automatic combustion control. An impulse in the form of a change in steam pressure actuates the impulse transmitter, which may be a bellows, diaphragm, or spring-opposed piston. In the master control, the impulse, which is now mechanical, is greatly magnified and converted into another impulse for transmission to the air and fuel feed controls. This latter impulse may be mechanical, pneumatic, liquid, electrical or whatever medium is considered desirable. The impulse from each control is converted by the feed operators into a mechanical motion actuating the dampers or other devices controlling the flow of fuel and air.

The master control must have a dial that will indicate the percentage of load the boiler is carrying and an adjustment so it will carry the desired pressure. Each feed control should have a dial registering the impulse from the master and another dial showing that this impulse is being transmitted to the operators. A transfer arrangement is necessary to change from automatic to manual operation when needed. All good combustion controls provide this transfer.

How Control Works

Small change in steam pressure (sometimes a change of only 1 lb) will operate the combustion control throughout its operating range. Obviously, this degree of sensitivity is not ordinarily required. A change of 4 lb pressure will generally operate the combustion control throughout its range. A slight change in pressure will, therefore, change the combustion control 5 per cent. From the chart, Fig. 2, we see the boiler dropped its complete load at 12 noon with a change in pressure of about 2 lb. At 1 p.m. the load was picked up again with a change from 2 to 3 lb.

A good combustion control is in constant motion, operating from changes in pressure the fireman can hardly see. The control cannot anticipate the change in pressure, but it can follow so closely that the change is minimized. The fuel and air feed operators must have a compensating arrangement to prevent overshooting when a change in pressure occurs. This feature gives the control stability, without which it could not function satisfactorily.

Fuel-Air Ratio

From a study of Fig. 5 it would seem possible for the regulation of fuel and air to be mechanically the same. In actual practice this is impossible. A higher percentage of excess air is required at the lower ratings than at the higher ratings. The air control damper must therefore operate at a progressively slower rate than the fuel control damper. This is generally accomplished by a

Basic Instruments — How They Work And What They Are Used For (Shown in Fig. 1)

UNDERGRATE PRESSURE GAGE

Purpose: — To tell if the undergrate pressure is being maintained. This gage is calibrated to read in inches of water. It tells if the forced draft fan is working properly or if the ash bed on the grates is too thick or the grates are clogged. If the gage suddenly reads zero, the operator knows the fan has stopped. If fuel is allowed to accumulate on the grates without the fan running, there is danger of an explosion. If the pressure rises too high, fan control may not be working right.

FURNACE DRAFT GAGE

Purpose: — To tell if the proper draft for maximum efficiency of the furnace is being maintained. This gage is calibrated to read in tenths of an inch of water. There is a correct draft for every furnace that will result in maximum efficiency. Once this draft is determined it should be maintained at all times. If too high a draft is carried, flue gas losses will increase. If too low a draft is carried, there is danger of explosions in the furnace. The proper furnace draft can generally be maintained by automatic control of the uptake damper.

UPTAKE DRAFT GAGE

Purpose: — To show the draft loss between the furnace and the last pass. This gage is calibrated to read in tenths of an inch of water. Once the proper differential is established, then an increase in differential will mean the air passages are becoming restricted and the boiler tubes should be cleaned. If the differential decreases in value, the baffling may be ruptured or some other fault will permit the gases to short-circuit.

STEAM PRESSURE METER

Purpose: — To record steam pressure continuously. It affords an excellent record as to when the boiler was fired up, how fast it was fired, when put on the line, and the operational difficulties occurring from time to time. It provides a check on the fireman and the combustion controls.

CO_2 OR COMBUSTION METER

Purpose: — To provide a continuous record of the carbon dioxide in the flue gases. It is an extremely satisfactory method of indicating the combustion efficiency in the furnace. Air is roughly 80 per cent nitrogen and 20 per cent oxygen. Perfect combustion in the furnace would therefore provide 20 per cent CO_2. For many and varied reasons, this degree of perfection is a Utopian dream; however, there is always a best condition for every furnace and fuel air condition. When this best situation is established, the CO_2 meter is a visual indication that proper conditions are being maintained. It is among the most valuable instruments ever installed in a boiler room.

FLUE GAS TEMPERATURE RECORDER

Purpose: — To provide a record of the temperature of the gases leaving the boiler. It indicates whether or not the boiler tubes are accumulating soot and when the flues should be blown. Also, it shows whether or not the flue blowers are working properly.

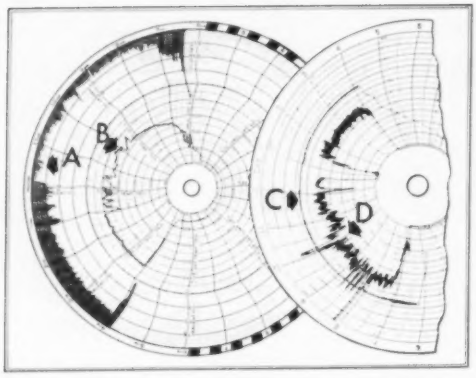


Fig. 4. Recorder charts showing what happened when a maximum load went on the boiler shortly after 8 a.m.: A — CO_2, B — Flue Gas Temperature C — Steam Pressure, D — Steam Flow. The boiler was crowded in morning

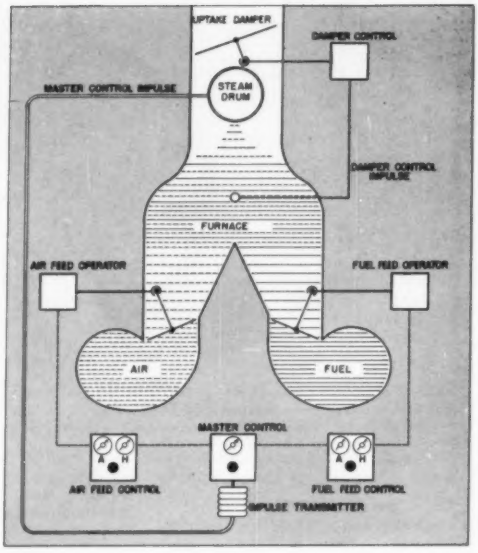


Fig. 5. Schematic diagram showing essentials of a typical combustion control

ratio linkage or a calibrated cam.

The uptake damper control is independent of the combustion control. It is operated by an impulse in the form of negative air pressure or draft from a static zone in the furnace. The damper control converts the impulse into mechanical motion and actuates the uptake damper. The device must also have a stabilizing feature to keep it from hunting.

Feedwater Control

Automatic combustion control at its best is inadequate unless the feedwater to the boiler is also automatically controlled. Hand operation permits wide variation in control. Automatic operation maintains the flow of water into the boiler in balance with the flow of steam out of the boiler.

In the steam drum of the modern steam generator there is very little space. Admitting too much water will some times reduce the steam output by as much as 50 per cent. In fact, only the hrt boilers with their huge steam release space permit hand regulation of boiler feedwater.

Basic essentials of a feedwater control are shown in Fig. 6. Speed of the turbine-driven boiler feed pump, and thus the water pressure to the boiler, is governed by a steam regulating valve. This valve is operated by a spring-opposed diaphragm with water pressure from the pump discharge on one side and steam pressure plus spring pressure on the other side. A water regulating valve is installed in the discharge line from the pump to the steam drum. The water pressure on the primary side of the valve will usually be about 40 lb higher than the steam pressure.

How Control Works

Assuming the water level has dropped in the steam drum, the control will function as follows: The float will lower, thus opening the water regulating valve. Opening the valve decreases the pressure on the primary side and on side B of the diaphragm. The spring then pushes against the diaphragm and opens the steam valve to the turbine, causing it to speed up, thus pumping more water into the boiler and raising the pressure on the primary side of the water regulating valve. This increased pressure reacts on the diaphragm of the steam regulating valve to restore equilibrium and provide stability. If the water level rises in the steam drum, the action is just the opposite.

When an increased load is thrown on a boiler there is generally a pressure drop in the steam drum. The combustion control responds and the stepped-up firing rate generates more steam bubbles, which in their rapid rise to the surface lift the water level in the steam drum. When this happens, the pressure is lowered on the A side of the diaphragm and raised on the B side to slow down the pump and thus enable the boiler to quickly meet the increased demand. As the steam pressure and water level stabilize, the feedwater controls function to supply more water to meet the increased demand for steam. A drop in load provides a reverse action.

Automatic control and instrumentation for the large boiler are absolute necessities and therefore widely used, resulting in considerable economy in operation. On the smaller boiler, the relative savings will be just as much and sometimes more. It might make for an idler fireman; but the gain in efficiency of operation makes the investment well worth while.

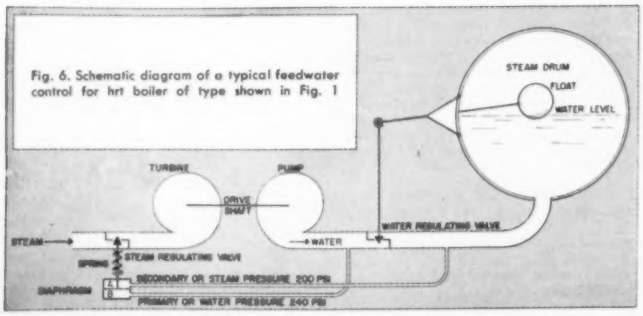


Fig. 6. Schematic diagram of a typical feedwater control for hrt boiler of type shown in Fig. 1

Pick the Right Thermal Expansion Valve

Correct sizing of thermal expansion valves for refrigeration systems helps insure full output and reduce valve wear. Here are some tips on proper sizing and selection and on figuring pressure differential

THERMAL EXPANSION valves are simply orifices equipped to automatically adjust the flow of liquid refrigerant through their passages. These valves are used to control the amount of liquid refrigerant admitted to the evaporator, in accordance with the refrigerant load. They enable any number of evaporators (or direct expansion coils) to be operated in parallel on one compressor — each coil with its own expansion valve.

Because expansion valve manufacturer's bulletins and many texts fully describe how thermostatic expansion valves work and where they are used, this article will confine itself to factors in their selection and sizing.

In order to select the correct size expansion valve for a refrigeration system it is necessary to know the pressure differential *at the valve*. This differential is simply the figure obtained by subtracting the low side (LS) from the high side (HS) pressure existing on either side of the expansion valve. Once this pressure has been calculated, the proper valve can be selected from manufacturer's tables.

The all-too-popular, rule-of-thumb technique of arbitrarily assigning 60 psi as the differential for all thermal expansion valves can lead to a costly loss in refrigeration capacity, according to Trane *Weather Magic*. If the 60 psi figure, or any other pressure differential is too low, the valve will be over-sized and tend to hunt, causing fluctuations in the amount of refrigerant fed to the evaporator. If the orifice is too large because the valve was selected for too low a differential, it will pass too much liquid refrigerant each time the valve opens. If the orifice is too small because the differential was figured too high, the expansion valve will not pass sufficient refrigerant, "starving" the evaporator and reducing the system's capacity.

In figuring the pressure differential at the expansion valve, pressure drops in lines and equipment must be taken into account. Line losses through evaporators, condenser, valves, fittings, strainers, etc., must all be calculated to come up with the right answer for accurate expansion valve selection.

Calculations Made Simple

Here is a simplified method of calculating pressure differential —

Low Side. A. Add pressure drops through: refrigerant distributor (from manufacturer's literature); evaporator (from manufacturer's literature); and suction line, from compressor to evaporator, accounting for all fittings, valves, etc. (from standard tables giving Freon gas friction losses through pipe and fittings).

B. Add total from item A to the suction pressure at the compressor. This gives the total suction pressure on the low side of the expansion valve.

High Side. A. Add pressure drops through: liquid line, due to friction of liquid refrigerant (from standard tables on liquid Freon flow through pipe); and liquid line, due to elevation (where evaporator is installed above the condenser, based on 0.55 psi pressure loss per foot of elevation).

B. Subtract item A total from condenser pressure (condenser pressure known, as a factor of selection).

For example: condenser pressure is 130 psi. Liquid line pressure drop due to friction has been figured to be 3.2 psi. There is a 15 ft vertical liquid line between the condenser and expansion valve.

$0.55 \times 15 = 8.25$ psi loss due to elevation.

$8.25 + 3.2 = 11.45$ total pressure drop on the high side.

$130 - 11.45$ (condenser pressure) $=$ 118.55 psi, high side pressure at the expansion valve.

Subtracting high side pressure from low side pressure at the expansion valve gives the required pressure differential, on which to base valve selection.

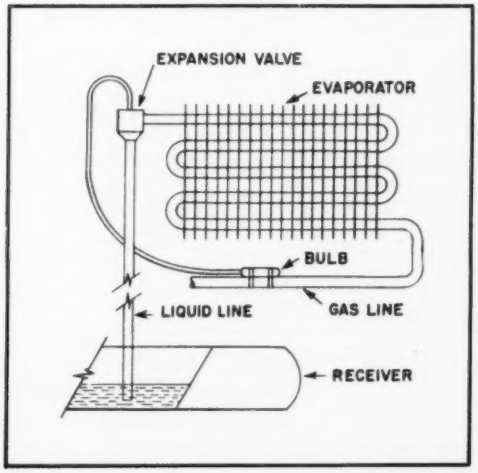
Flash Gas Cuts Capacity

Expansion valve capacity may be reduced in cases where an evaporator is installed above a condenser, as in sketch. Expansion of liquid refrigerant in a vertical liquid line from the condenser to the evaporator will cause flash gas to form. Because it displaces some of the liquid refrigerant, flash gas in liquid line cuts down expansion valve capacity.

Flash gas in vertical liquid lines can be eliminated by sub-cooling the refrigerant. This can be done by passing the liquid Freon through a coil in the sump tank of an evaporative condenser, or by the use of a suction-to-liquid heat exchanger, or both. The suction-to-liquid heat exchanger allows the liquid refrigerant to pass through tubes around which flows the colder gas from the evaporator. The liquid is sub-cooled by losing heat to the suction gas.

In addition to sub-cooling, liquid lines may also have to be insulated under certain circumstances to avoid flash gas. Where liquid lines pass through high temperature areas, causing the liquid refrigerant to pick up enough heat to cause it to boil at the temperature corresponding to its pressure, insulation should be applied.

Remember, in sizing a thermal expansion valve, account for all pipe friction losses up to the valve, on both sides of the system. Take into consideration the drop through the evaporator and fittings, and the losses due to elevation of the liquid line. An accurately sized valve, with respect both to pressure differential and tonnage, helps insure efficient evaporator operation and prompt adjustment of the evaporator output according to load demands.



Typical installation where evaporator is above condenser. In such installations, flash gas can be eliminated by sub-cooling refrigerant

Oxygen—An Important Raw Material in Industry

TOTAL consumption of oxygen in the U. S. has risen far above what is required to sustain 155,000,000 persons, countless plants and animals — or what is required to permit other natural forms of combustion. But there is little fear, common with many materials and elements, of an oxygen shortage.

Even though oxygen is spectacularly abundant (comprising 77 per cent of the earth's water by weight, 47 per cent of the earth's crust, and 23 per cent of air by weight), until recently there *was* a "shortage." Cost of producing the pure gas as well as lack of large-scale production facilities prohibited its extensive use.

Oxygen now is being produced in ever-increasing amounts, 21.7 billion cu ft annually, for use in more and more fields for as little as 12.5 cents per 1000 cu ft (at 80 F and 1 atm). Tonnage oxygen, where single plants now manufacture as much as 1500 tons per day, has accounted for increased use and lower cost. Output of such a plant for one week compares roughly with the entire production of cylinder oxygen 35 years ago. It is estimated in the future that the cost of production may become as low as 4.7 cents per 1000 cu ft.

Purity of Tonnage Oxygen

Tonnage oxygen usually varies between 90 and 97 per cent purity. Except for welding and cutting which requires oxygen of 99.5 per cent purity, tonnage oxygen is suitable for nearly all the present industrial and commercial uses. In addition, tonnage plants are capable of turning out large quantities of the purest oxygen as well when needed.

The advantage of oxygen in most industrial uses is, of course, the elimination of nitrogen. This is especially true in the steel and related industries where oxygen is being used with good results in open hearth and Bessemer steel production for enrichment with a resulting higher yield per charge and lower fuel cost; in combination with carbon dioxide in blast furnaces which results in more output per cu ft of furnace size; in improving cupola output in the smelting of ores; and in the production of high alloy steels in electric furnaces.

At least one company has been experimenting with the use of oxygen in combustion in the furnaces of a steam generating unit. Quantity oxygen is an essential commodity in the synthetic gasoline processes now under development. Use of oxygen in underground gasification of coal (POWER GENERATION, October 1948) is being investigated and may help in generating at the mine a pipe-line gas for power, industrial and domestic use.

This table presents in compact form all the known important physical and chemical properties of oxygen. Compiled by the Blaw-Knox Construction Company

CHEMICAL AND PHYSICAL PROPERTIES OF OXYGEN

Chemical Symbol	O_2
Atomic Number	8
Periodic Group	VI
Atomic Weight	16.00
Molecular Weight	32.00
Molecular Diameter	3.39×10^{-8} cm
Isotopes	16, 17, 18
Allotropes	Ozone (O_3)
Valence	2 and 6
Concentration in Dry Air	20.93%
Boiling Point (atm. press.)	−183.1°C
Melting Point	−218.8°C
Critical Temperature	−118.8°C
Critical Pressure	49.7 atm.
Critical Density	0.430 gm/cc

Vapor Pressure at Various Temperatures

Pressure mm. Hg	Temperature °C
0.76	−219.8
7.60	−211.5
76.0	−200.6
190.0	−194.3
380.0	−189.0
760.0	−183.1

Latent Heat of Vaporization	1635.8 cal/mol @ B.P.
Latent Heat of Fusion	106.0 cal/mol @ M.P.
Heat of Reaction with Carbon (Coke)	97,000 cal/mol
Heat of Reaction with Carbon (Graphite)	94,400 cal/mol
Heat of Reaction with Hydrogen	68,317 cal/mol

Boiling Points of $O_2 - N_2$ Mixtures: 1 atm. Pressure

O_2%	BP °K
90	87.7
95	88.9
98	89.9
99	90.0
99.5	90.1

Entropy: 1 Atm.

T °K	Cal / gm mole °K
50	12.52
100	40.58
150	43.31
200	45.36
250	46.84
273.1	47.75
298.1	48.04

Molal Volume: 0°, C, 1 atm. (g) 22,397 cc

Specific Gravity: @ 0° C (g)	1.429
@ −182.9° C (l)	1.14
@ −252.5° C (s)	1.426
Specific Heat: BP to 25°C (g)	6.98 cal/gm mol.
−183° to −200°C (l)	12.62 cal/gm mol.
−221.8°C (s)	10.74 cal/gm mol.
Coefficient of Thermal Expansion: 0° C to 100° C (g)	3.674×10^{-3}
−195° C (l)	4.10×10^{-3}

Compressibility Factor: PV = 1.0 @ 1 atm., 0° C

P, atm.	0°C	50°C	100°C	200°C
1	1.0000	1.1838	1.3674	
10	0.9913	1.1796	1.3661	
50	0.9569	1.1642	1.3630	
100	0.9234	1.1520	1.3651	
200	0.9140		1.4000	1.8190
300	0.9625		1.4530	1.8850
400	1.0515		1.5320	1.9610
500	1.1560		1.6220	2.0500

$\frac{C_p}{C_v}$ (atm. pressure)

0°C	$\frac{C_p}{C_v}$
15	1.401
− 76	1.415
−181	1.45

Vanderwaal's Constants: $a = 1.360$ (liter^2, atm. mole^{-2}); $b = 0.013183$ (liters, mole^{-1})

Solubility in Water:	4.89 cc in 100 cc @ 0° C
	2.6 cc in 100 cc @ 30°C
	1.7 cc in 100 cc @ 100°C

Viscosity:
@ BP (g) 0.00736 CP
@ MP (l) 0.883 CP
@ 0°C (g) 0.0192 CP
@ −193°C (l) 0.245 CP

Moisture Content of Saturated Oxygen .130 gm/ft^3 @ 0°C

Thermal Conductivity:

	cal / cm-sec-°C
0°C (g)	5.7×10^{-5}
−78.4°C (g)	4.29×10^{-5}
−191.4°C (g)	1.72×10^{-5}

Index of Refraction: −181°C (g) 1.221

How to Start Up and Shut Down an Integral-Furnace Type Boiler

By SAMUEL R. GREEN

Here is a handy, concise check list used by the author to safely and efficiently start up and shut down one of his boilers. . . . Devised for an integral-furnace type B & W boiler, rated at 163,000 lb per hr and operating at 415 psig, this list gives practical operating procedure for many similar types of boilers

STARTING UP

1. Open drum vent valve wide.
2. Open both inlet and outlet superheater drain valves wide.
3. Fill boiler to 3-in. in lower water glass.
4. Open forced draft dampers wide.
5. Start induced draft fan and purge boiler settings with all air registers open.
6. Close all air registers except for the one burner to be lighted and adjust the induced draft damper to about 1.5-in. at air heater outlet.
7. Block open the solenoid operated oil inlet valve. It is assumed that the oil header at the boiler front had been warmed up to the desired oil temperature by circulating hot oil through the return oil header.
8. Light one burner with a small size burner tip (we use a No. 1320 tip, normally a No. 1515 tip), and adjust fuel oil pressure with the oil return valve to control firing rate. Adjust the induced draft damper to give proper amount of air—about 1.2-in. at air heater inlet.
9. At 20 psig steam pressure, close the drum vent valve and throttle the 1-in. superheater inlet drain valve to ½ turn open.
10. Bring steam pressure up by adjusting the 11.2-in. superheater outlet drain valve. To increase the rate of pressure, throttle the 1.5-in. superheater outlet drain valve, but do not close this valve below ½ turn open for SH tube protection.
11. If pressure rises faster than indicated on the chart (step 12) with the superheater outlet drain valve (1.5-in.) wide open, *the firing rate must be reduced.*
12. Rate of pressure rise recommended:

Time	Steam Pressure
1 hr	0 to 25 psig
1 hr 15 min	25 to 50 psig
1 hr 30 min	50 to 80 psig
1 hr 45 min	80 to 120 psig
2 hr	120 to 175 psig
2 hr 15 min	175 to 235 psig
2 hr 30 min	235 to 315 psig
2 hr 45 min	315 to 415 psig

Note: During time boiler is being brought up to pressure, warm up steam header, and open its boiler stop valve. Also open boiler non-return steam valve, so boiler can come in on line automatically.

13. When the boiler pressure is within 40 lb of line pressure, hand lift all safety valves.
14. After boiler pressure is up and on the line, close the superheater outlet drain valves.
15. Time of 2¾ hr represents the time needed to go from a cold boiler to a boiler on the line.

SHUTTING DOWN

1. Secure all burners and stop forced draft fan.
2. Close induced draft fan dampers.
3. Crack superheater outlet drain valve about ¼ turn.
4. When no more steam is being generated (about 1 hr after burners are secured) close non-return and steam header stop valves, and bleed out steam header pressure.
5. Reduce pressure at the following rate by drawing air through the boiler with the induced draft fan. Also, open forced draft fan dampers wide, open burner air registers wide, and control air flow through boiler with induced draft fan damper.

Time	Steam Pressure
30 min	415 to 315 psig
1 hr	315 to 235 psig
1 hr 30 min	235 to 175 psig
2 hr	175 to 120 psig
2 hr 30 min	120 to 80 psig
3 hr	80 to 50 psig
3 hr 30 min	50 to 25 psig

6. Open drum vent valve at 25 psig pressure.
7. Close off continuous blowdown valve at boiler drum.
8. During the above operation, keep water in sight in gauge glass by feeding water when necessary.
9. This is the maximum rate of cooling the boiler down. It is better to take approximately twice as long, if possible.

HOW TO MAINTAIN COOLING TOWER LUMBER

THE DESTRUCTION of cooling tower lumber, especially redwood, generally has two causes which are called arbitrarily chemical attack and biological decay. Chemical attack can be explained from consideration of the basic chemistry of wood and various components of water circulated in cooling towers. Biological decay is caused by various microorganisms, primarily of the fungus family. There are some indications that bacterial growth also may contribute to this phenomenon.

Cooling Tower Institute's Technical Subcommittee 3 in their latest progress report has set forth a brief memorandum of recommended practices in the operation of cooling towers. These general recommendations which follow are presented in the light of the best knowledge to date, but the subcommittee warns they should *not* be taken as rigid rules to be followed under *all* conditions.

1. For the control of delignification and, possibly to some extent, fungal infection, cooling tower water should be kept at a pH preferably between 6.5 and 7.5. Although pH is not the sole criterion for delignification, conformance to these limits should eliminate from most waters the constituents which cause such a condition. Suitable corrosion inhibitors should be added to the water to protect metal equipment.

2. Where halogen (chlorine or bromine) algicides are used, residuals in the water should not exceed 1 to 2 ppm to avoid oxidizing effects of excess halogen on the lumber.

3. In most cooling towers some algicide should be used for proper protection of metal cooling equipment and the towers. At this time there are no specific recommendations of algicides, which may be halogens, pentachlorphenol, or quaternary ammonium salts.

4. No recommendation can be made at this date for elimination of fungus infections, other than infected lumber when discovered should be removed immediately from the tower and replaced with new lumber. It is fully expected current investigations will lead to satisfactory solutions of the fungus infection problem at a later date.

5. General good housekeeping is essential to proper operation and maintenance of cooling towers. Proper maintenance should include regular periodic inspections, at which time scale and encrusted salt should be removed, water boxes, basins, and screens thoroughly cleaned, and all debris and detritus removed.

Spot Tests Aid in Scrap Salvage

Fig. 1. Four reagents, a magnet and medicine dropper comprise equipment for easy identification of 9 wrought white metals and alloys in scrap salvage

Scarcity of critical materials makes salvage important . . . A few basic reagents and simple tests make quick identification of valuable metal easy . . . Complete booklet lists reaction charts and procedure for testing more than 125 important metals and alloys

RAPID, sure identification of common metals and alloys is a necessary part of plant operations for the segregation of materials, and for optimum salvage of scrap. To accomplish this, simple tests that can be made on the spot will identify and classify strategic metals for recovery. This is especially true in the case of some of the alloys, in which the shortage may be more critical than in ordinary metal.

Tests Are Simple

Four reagent bottles, a magnet, and a small medicine dropper or glass rod, all as in Fig. 1, are all that are needed to classify 9 common wrought white metals and alloys. This equipment, small and compact, can be carried to any point in the plant for quick tests to identify scrap or metal to be recovered.

The 4 reagent bottles contain respectively distilled water, 10 per cent solution of potassium ferricyanide, concentrated hydrochloric acid and concentrated nitric acid. A "mobile laboratory" such as this enables you to distinguish among any of these 9 metals: nickel, Monel, Inconel, Incoloy, 70/30 cupro-nickel, and 4 grades of stainless steel — 304, 310, 321 and 430.

Here's How You Do It

For example, suppose an unknown metal of medium density (easily distinguished from other white metals of heavy or light density by weight) has strayed from its stockpile or has become mixed in with an obviously different material.

First, you clean the specimen of dirt, grease or corrosion products with emery paper.

Next, you add 1 drop of 10 per cent hydrochloric acid (4 parts distilled water to 1 part concentrated hydrochloric acid) and allow it to react on the clean surface for 1 min.

Then you add 1 drop of potassium ferricyanide and wait 30 sec, whereupon a distinct color will appear where you dropped the chemicals.

Dark green or blue indicates the material is Incoloy or one of the 4 stainless steels (called Group A). BUT — if there is NO color, or a red, green or yellow-brown color, the material is nickel, Monel, Inconel or 70/30 cupro-nickel (called Group B). Time elapsed? Probably 5 minutes.

Assuming with this particular metal a blue color appeared, the next step is to test the material with the magnet. If definitely magnetic, it is stainless steel 430. If generally non-magnetic, add a drop of concentrated hydrochloric acid; then, after 1 min, a drop of 10 per cent potassium ferricyanide. Thirty sec later, if the spot tested is white with black edges, the material is stainless steel 310.

Further steps pinpoint the remaining metals if no such reactions are evident. In like manner, if at the beginning of the test the color indicated the metal was of Group B, progressive tests with the 4 reagents and magnet will easily identify the metal in this group. Total time? Not more than 15 min.

In identifying metals other than the 9 first mentioned, it is necessary, of course, to employ more reagents. Simple, spot-testing procedures for all metals and alloys commonly used have been made available by the International Nickel Co., Inc., along with the outline of procedure for the 9 white metals.

A complete booklet lists tests for identifying more than 125 metals or alloys, including 7 types of alloy steel and 12 types of stainless steel. Fifty-six reagents are listed as necessary to carry out the identification tests.

Metals in the large outline are divided into 4 basic classifications according to density. These include the very heavy metals (sp gr 12 to 22) such as gold, tungsten, platinum and iridium; the heavy metals (sp gr 9.8 to 11.3) such as lead, silver and bismuth; the average density metals (sp gr 6 to 9) such as steels, irons, copper and copper alloys, nickel and nickel alloys, tin and zinc; and the light metals and alloys (sp gr 1.5 to 3) such as aluminum, magnesium and light alloys.

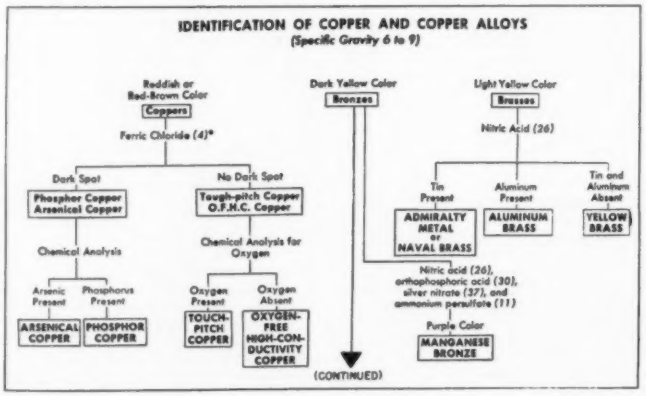
Charts and Procedure

In each case, the testing booklet presents a reaction chart, Fig. 2, as well as complete written procedure. It will seldom be necessary to use the entire systematic procedure. Ordinary familiarity with his own plant processes and the charts presented in the outline will nearly always enable the operator to eliminate many materials from consideration before he begins to test. A table of chemical compositions of all metals is also included in the outline.

The procedures described are qualitative only. Quantitative results must be secured by spectrographic or chemical analysis, or by one or more of the special testing methods which may be applicable for the purpose.

The complete booklet, Rapid Identification (Spot Testing) of Some Metals and Alloys, as well as the outline on the 9 white metals, may be obtained free. If it will help you, write the Editor for a copy.

Fig. 2. Reaction chart for the identification of copper and copper alloys visualizes simple testing procedure explained in booklet. Note that the tests for all the bronzes contained in the chart are not shown here



The Great Gas Works Strike

Oscar the Gas Works Owl steps—or should we say footprints—into a very tense situation that threatens to shut down the gas works. Blackmail, threats, murder in the eye, shirts, washing machines, sweat, bucks—all are involved in a tangle of motives. But Oscar skillfully points out how "fair xchange is no robery" and shows John Raven how to unravel the tangle. Naturally, some succulent mice repay Oscar

By JOHN RAVEN

ONE DAY I was moping in my office with my thoughts more sad and low than usual, on account of 330 lb of obstinate blubber facing me across the desk.

"Tiny Tuttle," I said, addressing this sweating heap more in anger than in sorrow, "as head of the machine shop you may be a respected machinist, but no matter how respected you are, the gas works won't buy you a washing machine and ironer, and you can't blackmail me into getting them. I don't care if machine shop production does fall off 50 per cent, like you threaten. And I don't care if the Boss does fire me for it. That's final."

The way the drops of sweat shone on his 6-lane forehead, he looked like Broadway. He wiped them off with a paw that was hardly bigger than a city gas holder; and he puffed at me in these words:

"John, you know I can't work good when I'm all sweated and drafts gimme colds. So I gotta change my shirt every other day, and not havin' no wife to wash and iron, the laundry busts them up so fast I gotta buy 2 new ones every week. That's 10 bucks a week, and I can't afford it no more. Either you gotta buy me a washin' machine and a ironer so I can do my own shirts, or you gotta gimme 10 bucks more pay a week, or you gotta put up with less work from the machine shop like I said. I ain't blackmailin' you none, I'm just tellin' you what you gotta do."

". . . or you gotta put up with less work from the machine shop . . . I'm just tellin' you"

"I don't gotta do anything!" I yelled. "If you want a washing machine and ironer, buy them yourself. With *your* money! If you had any sense at all, you'd de-blubberize yourself and stop sweating like a worm-eaten water tank."

He gave me a sorrowful look from under a fresh crown of sweat drops, and heaved up and out of his chair like a stranded whale getting off the beach.

"John," he warned, "the other shops ain't gonta like it, you lettin' the machine shop slow down. We can't hardly keep up with their work as 'tis. And what'll the Big Bushwah say?"

He oozed and flowed toward the door like a tidal wave in greasy dungarees, and just as he was about to go out, he turned and puffed:

"Can't we compromise nohow, John?"

"Sure," I said. "Just go back to work and we'll both forget the whole thing."

His big head waggled regretfully.

"Well, I was just askin'. I guess tomorrow's gonta be a slow day."

I thought the trail of sweat he left behind was black, but it was merely the reflection of my own feelings. Within 24 hr the whole gas works would feel the slow-down. the Boss would hear of it and change my name to mud. I was still trying to figure out what to do when an earthquake hit me in the form of my screaming buzzer and wild bellows from the Boss. I figured Tiny Tuttle had stopped in and told him the whole story, but when I reached his office at my fastest crawl, what should I see but three other guys. A quick look told me they were Gus the Swede, Pipenose Henry, and a string bean called Shorty, all from the pipeshop.

"Confound you, John," bellowed the Boss, with his three chins flying up and down like an elevator out of control, "Why didn't you tell me the pipefitters were going out on a strike? Whoever heard of a strike in the gas works? It's treason! You've let treason grow right under your nose. Why shouldn't I fire you on the spot?"

Gus the Swede wiggled his yellow mustaches apologetically.

"Sir," he said, "It ain't as bad as it seems. All we want is 3 bucks a week raise, to meet the cost of livin'. We ain't been raised in 15 years. Give us 3 bucks and there won't be no strike."

The Boss thumped his desk so hard the pen set jumped off and rolled under it.

"Three dollars a week!" his big voice rattled the windowpanes. "Do you men think the gas works is made of money? John, how could you ever let them think such things?"

"Boss, listen," I put in desperately, "This is the first I've heard they want more money. And besides," I added with a bravery that surprised me, "Fifteen years is a long time to go without a raise and I think 3 dollars is reasonable."

The Boss soared to his feet in best manner of Hollywood tragedy, and gave me the reproachful look of a man who has just been stabbed in the back by his best friend.

"To think, that you too, John, sympathize with this treason! Gas works, this is a black hour in your history!"

He wiped his eyes as though brushing away a tear, then seeing no tears in anybody else's eyes, became the wise teacher talking to little children.

"Gentlemen," he said in a bedtime voice, "do you realize we must increase gas rates to give each of you a 3 dollar raise? Obviously, if your raise goes into bigger gas bills for frying your eggs and bacon, you are no better off than now. Have you considered that?"

Gus and Pipenose and Shorty looked from one to the other uncertainly for a moment, then Gus said:

"Sir, we didn't think of that. Excuse us a minute while we talk it over."

They went into the corridor where they whispered among themselves while the Boss admonished me thusly:

"John, your failure to keep these pipefitters satisfied is inexcusable. Don't you know it takes tact and diplomacy to handle people? Why couldn't you figure out for them that a raise would cost them higher gas rates? Are you too dumb, or what?"

There is no use arguing with the Boss, so I just said diplomatically:

"If I could figure like you, I'd probably be a boss somewhere, myself."

He nodded his head reflectively, the stuffed shirt.

"Yes, I guess we top executives do have special powers. Now watch how quickly they'll agree with me. They'll eat out of my hand."

The pipefitters came back. The Boss beamed at them genially.

"Now that we've settled this raise business," he said, "can I do anything else for you before you go back to work?"

The men looked uncomfortable.

"Sir," said Gus the Swede, "we want to change our demands. We now want 3 bucks a week raise, plus whatever extra we've got to pay for gas. We thank you for remindin' us about the extra gas cost."

For a minute the Boss looked as though he had been hit with a club, then the red commenced running up his three chins and over his face like a storm tide out of control. There was a long silent time while he arranged his thoughts diplomatically in very strong words indeed.

"You dirty chiseler!" he yelled. "I never heard of such gall! You disgrace the gas works! I've a mind to fire you right now, and if I do, every decent man in the place will cheer!"

I could see the pipefitters needed only steel helmets and guns to make it a full war. An angry tremble came into the reply of Gus the Swede.

"The hell they'll cheer," said Gus. "If you fire us, or we strike, I bet the whole damn place strikes too, by yumpin' yiminy!"

"I don't believe it," yelled the Boss. "I don't believe a word of it."

He heaved his chair out of the way and jabbed a fat finger toward Gus as though it were a sword. His eyes popped suddenly out of his fat face like twin stop-lights.

"Are you trying to add blackmail to your treason?"

He looked so much like murder about to happen . . . I backed toward the door

"In a compromise, each side must get something . . . fair exchange is no robbery"

As they stood there glaring at each other, something that resembled a gas holder in dungarees elected to come sweating and blowing into the office.

"Excuse me," puffed this mountain of blubber, "but I gotta tell John if I don't get no 10 bucks a week or a washer and ironer, we ain't gonta slow down in the machine shop like I said. We just ain't gonta work at all. Come tomorrow, we go on strike."

The Boss blinked from Tiny Tuttle to me, and I could sense he was hit in the wind. "Boss," I advised hastily, "Go easy. Let me explain."

"You see?" Gus crowed. "What'd I tell you?"

"The Boss Sets Sail"

The Boss visibly pulled himself together, and set sail around his desk like a battleship with a bone in its teeth, and I didn't need a radar screen to tell me his destination was John Raven. He looked so much like a murder about to happen, that even Tiny Tuttle ebbed out of his path. I backed up to the door, and got set for a flying start that would carry me at least a mile outside the gas works gate, but unexpectedly he stopped in the middle of the room, probably realizing he was too fat to catch me. He arranged his face into a martyred expression.

"John," he said in the voice of a brave and noble man overcome by fate, "Heaven knows you deserve no kindness at my hands, but since this deplorable situation is all your fault, I shall give you a chance to make amends. In the greatness of my spirit, I grant you one hour in which to settle these strikes. If you fail, never let me see your face again."

Then he dropped his three chins on his chest, and with hands dangling in the best ham actor style, he added these heart-breaking (he hoped) words: "Now I go to the dispensary, to seek balm for the terrible shock this treason has brought me."

After he made his exit, leaving me as usual to be the public goat, I was so mad I didn't care what happened.

"Jeez, John," said Gus. "We didn't mean to put you on the spot. What can we do?"

"Let's compromise," suggested Pipenose hopefully.

"Nuts!" I said. "You guys are stubborn as the Boss. I'm through."

I went back to my office and commenced packing my things. The pipefitters and Tiny followed me and watched like I was the corpse at a wake. When I got to my drawing board, the first thing I saw was a mess of overturned India ink and a lot of henscratchings contributed by Oscar the Gas Works Owl. Since I didn't care what happened, I read out loud what Oscar had written:

njuneers shud remember (I read) in a compromise each side must get something 4 themselves its like fair xchange is no robery n u try it bcaws it wrks yr frend oscar the gas wrks oul hoo sees al n nos al

Things Cleaned Up

"Say, John," puffed Tiny Tuttle, "that ain't a dumb idea. Suppose I paid the gas works the reg'lar laundry rate 'til the washin' machine and ironer was paid for. Would that be a O.K. compromise?"

I thought it over for a minute, and it didn't take much imagination to see gas-works wiping cloths and whatnots going into that washing machine. In no time, Tiny would be happy and the gas works would have new and useful equipment, at no cost.

"Tiny," I said, "It's a deal."

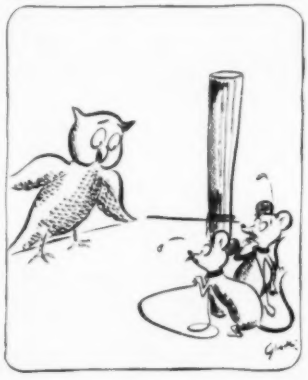
This fair exchange technique gave me another idea.

"Gus," I said, "if I get you guys a 3 bucks raise, will you change your clothes before starting time in the morning and after quitting time in the afternoon? You get your raise and the works gets a little more time, sort of a fair exchange arrangement. What do you say?"

"Not me," said Pipenose. "I hate to get up early."

"You always was lazy," said Gus disgustedly. "As spokesman for this shop, John, I says we'll take it. Now you can call the Big Bushwah and tell him the strike is over, by yumpin' yiminy!"

I reached for the telephone, but not to call the Boss. First, I had to order some mice for a very good friend of mine.



Lignite Burned on Spreaders Cuts Paper Mill Steam Costs

Ready accessibility of lignite fields plus low priority of the fuel dictated conversion from coal at Canadian mills

COMPLETE CONVERSION to lignite from coal at a Kenora, Ontario, newsprint mill, and partial conversion at a pulp and paper mill at Fort Frances, Ontario, has resulted in a substantial reduction in steam costs for the owners. The conversion to lignite was begun at Kenora in 1948 after a study revealed several advantages: lower transportation costs would make lignite much less expensive (Canadian lignite fields were much nearer than U. S. or Western Canadian coal fields); lignite was less susceptible to sudden defense needs or unusual developments in the coal industry; installation of new stokers would allow use of either lignite or coal. Completed in 1950, first-year operation at Kenora showed that alterations necessary on the four furnaces also increased steam capacity.

New Stokers

New spreader stokers (Fig. 1) were chosen by the Minnesota and Ontario Paper Company to replace old underfeed stokers, badly worn after 25 years of service. The ability of the spreader stoker to fire either lignite or soft coal gives the company flexibility in the choice of fuel.

Installation of the stokers involved tearing out the underfeed stokers and modifying the brick and steel setting of the boiler units. Now there are no moving parts within the furnaces and a greatly reduced fuel bed depth is needed when under a full steam load. The addition of water-cooled walls effectively protects the furnaces from excessive temperatures and provides an additional steam capacity of 40,000 lb per hour, at Kenora. These alterations keep maintenance and replacement costs to a minimum. During the first year's operation at Kenora, maintenance costs were negligible compared with those involved with the underfeed stokers and coal.

In addition overall efficiencies have been comparable to other types of fuel and equipment, despite the fact that lignite produces only half the heat of soft coal formerly used. An average analysis for lignite received at Kenora during December, 1951, is as follows: Moisture, 33.72 per cent; Ash, 5.84 per cent; Sulphur, 0.55 per cent; Btu per lb, 7178.

In practice frozen lignite stripped from the seams in Saskatchewan is loaded directly onto cars without stockpiling. Still frozen when it arrives at Kenora, the fuel is free-running from the cars. Inherent moisture in the lignite sweats out and freezes in the cars so seldom that Kenora's coal handling problems have disappeared.

Overcoming Ash Problems

The ash problem was licked by the use of a pneumatic ash and fly-ash conveyor system. When coal was used prior to 1948, the ash was wetted down and handled in ash cars. Lignite ash cannot be wet down without packing the ash in the pit, making removal a near impossibility.

Now the pneumatic system sucks the ash from the pit to a receiver tank (Fig. 2), where it is unloaded into rail cars by a dustless loader. The loader has a rotating, mixing drum equipped with water sprays. As the drum rotates, a scraper bar mixes the ash and water. The bar then pushes the wet lignite ash down a chute to a waiting rail car.

Ash at Fort Frances is crushed and then sluiced hydraulically through a pipe line. Clinkers and coal ash from the one furnace (of four) not yet converted make this method necessary.

Fig. 1. Foster Wheeler spreader stokers at Fort Frances. Three of four stokers were installed in 1950, fourth will be converted to lignite operation when unit is replaced. Four similar stokers installed at Kenora

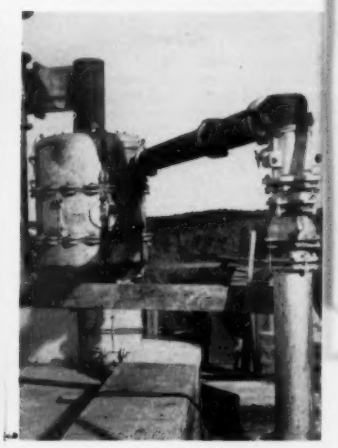


Fig. 2. Receiver tank on roof of ash bunker. Air drawn down from tank creates suction in the tank

CARE OF PAINT

By C. V. DENNY

PAINT can be prevented from hardening in buckets or cans by frequently changing the end the can is sitting on. Turning the lid end down after use provides a better seal against air than does the usual lid-end-up position. It also prevents the solids from settling and remaining too long in one position. This is especially true if the bucket is partially empty. If most of the oil has dried out due to improper stoppering, add linseed oil and stir. Sometimes paint that is almost hard in the container can be revived by adding linseed oil and persistent stirring.

The idea of changing the end positions of containers to prevent hardening before use applies whether they have been opened and part of the contents used or the original container has not been tampered with.

How Equipment Adaptability Aids Preventive Maintenance

By **F. L. BRADLEY,** Forstmann Woolen Co., Passaic, N. J.

Design modifications are usually made for one of two reasons or both. First, to get a better operating piece of equipment, and second, to make it easier to service. A change in a water softener improved the design and aided maintenance—

MUCH HAS BEEN SAID and is still being said about the value of preventive maintenance. If the power plant is to supply the services that are the very lifeblood of production operations, then preventive maintenance is a must to ensure continuity of its supply.

Adaptability of equipment by corrective design measures often provides an effective approach to preventive maintenance problems. Figure 1 illustrates a simple change that successfully overcame a design weakness. The zeolite softener shown is a gravity type unit extensively used in industrial power plants. It consists of a cylindrical wooden tank 12 ft in diameter and 10 ft high. The softening medium, a zeolite sand bed 3 ft-4 in. thick, rests on a 16 in. deep gravel ballast around and on top of the brass drainage system at the bottom of the tank.

Its Fault

The Achilles heel of the softener unit — the vulnerable spot — is exposed during the backwashing operations. A surge of water of excessive pressure due to careless opening of backwash water valve can and frequently does upset the gravel bed. This tends to blow holes in the zeolite bed. The resultant uneven flow through the zeolite bed when the unit is returned to service may permit *hard* water to pass the softener and into the boilers. If this condition goes undetected for an appreciable period, hard scale deposits can be built up in the boilers. The *pressure* type softener is even more vulnerable to gravel bed disturbances. This is due to the difficulty in inspection and test of the condition of its zeolite bed. These factors were discussed in the author's paper before the recent Plant Maintenance Conference. He then showed how the softener was improved.

How Corrected

A simple but successful corrective measure was effected by installation of an 8 by 8 mesh 18 gage copper screen to control movement of the gravel bed. The screen mounted on a supporting framework of brass angles was secured by flat brass strips. The entire structure was secured to the tank sides by a brass ring. Metal parts were insulated by sheet rubber at all points of contact. This alteration to existing units has been successful in preventing gravel bed disturbances since its installation approximately fourteen years ago.

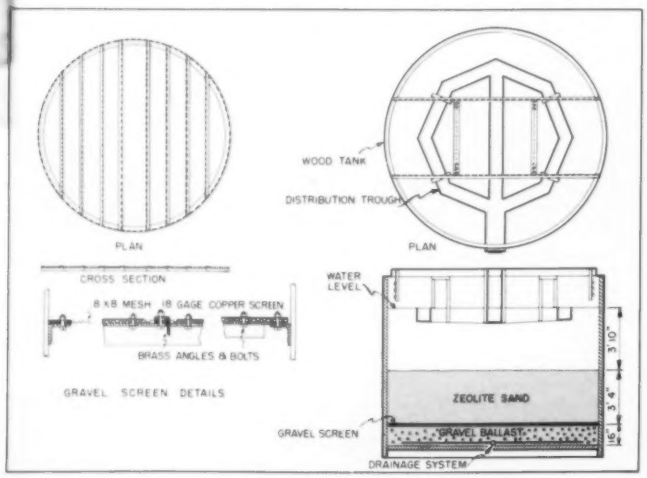


Fig. 1. Gravity type, zeolite water softener was modified by installation of copper screen as shown here

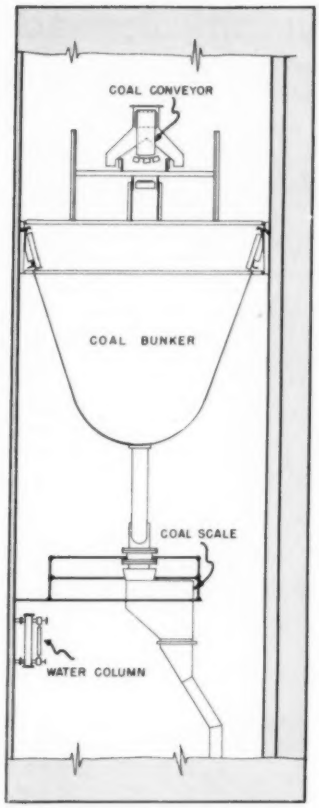


Fig. 2. Coal feeder system improved with stainless steel. Corrosion by wet sulphur coal and abrasion was materially reduced, so the coal will flow

Availability of new developments in the metallurgical or chemical fields may provide a solution to another troublesome maintenance problem. The coal feeder system shown in Fig. 2, in general, works very satisfactorily. However, difficulties developed with wet coal in the pipe between the bunker and coal scale and the discharge pipe from the scale.

While the slope of these pipes was initially adequate for positive flow of coal, flow was impeded as corrosion of the steel platework developed surface roughness. The operators lived with this condition until approximately two years ago when extensive corrosion made replacement of individual feed pipes necessary. Changes in shape or dimensions were either not possible or too costly. Present day costs of stainless steel made its use economically possible in this replacement. Its resistance to corrosion from wet and high sulphur content coals made it desirable for long life. Its continually smooth surface has served to eliminate the main coal feeding problem.

Basic Power Plant FIGURING

What Happens in Steam Drum, Boiler or Tank if It Explodes?

By **WILLIAM H. ENGELMAN,** Mechanical Engineer, Cleveland, Ohio

EVERY POWER ENGINEER understands, of course, that vessels containing steam or hot water under pressure should not explode. If the manufacturer builds them to the very rigid Code standards, if they are properly inspected and maintained, if they are equipped with proper safety devices and controls, if they are properly operated, they do not explode. Considering the thousands and thousands of pressure vessels in operation in this country in boiler plants and industrial processes, the safety record is phenomenal.

Yet occasionally a drum or tank does explode because one or more of the necessary precautions was not taken. In many such cases, it will be found that the equipment was old, was built before modern codes and safety standards were in effect, or for some reason had an undetected flaw.

Certainly the means for preventing explosions of pressure vessels are well known.

But suppose something unforeseen or unpreventable results in a boiler drum or water tank explosion? Just why are such explosions so violent?

Many of my students have often asked that question. The answer lies in the tremendous expansion of steam or the flashing of hot water into steam, between the pressure in the vessel and the atmospheric pressure. In engines and turbines, we harness that stored-up expansive power, make it release itself gradually, under control, and do work for us, or give up its heat gradually to other substances as in heaters of various kinds.

But if we have an explosion, the release of the expansive energy is practically instantaneous. Let's put a few figures on some typical cases and see just what happens.

A hot water tank containing 5,000 lb of boiling water at 381.8 F and a pressure of 200 psia explodes into the standard atmosphere of 14.7 psia. Calculate:

a. The pounds of water flashing to steam.
b. The volume of steam in cubic feet after explosion.
c. The volume of water in cubic feet before explosion.
d. Ratio of volume, water versus steam.

The following values are taken from Keenan & Keyes steam tables:

Enthalpy of the liquid at atmospheric pressure of 14.7 psia...	180.1 Btu.
Enthalpy of evaporation (flashing) at 14.7 psia.....	970.3 Btu.
Enthalpy in 1 pound of steam at 14.7 psia.....	1150.4 Btu.
Enthalpy of the liquid at 200 psia.....	355.4 Btu.

Let: s = pounds of water flashed to steam.
$(5{,}000 - s)$ = the remaining water.

Enthalpy in liquid = $5{,}000 \times 355.4 = 1{,}777{,}000$ Btu.

$(5{,}000 - s) \times 180.1 + 1150.4\ s = 1{,}777{,}000$
$900{,}500 - 180.1\ s + 1150.4\ s = 1{,}777{,}000$
$-\ 180.1\ s + 1150.4\ s = 1{,}777{,}000 - 900{,}500$
$970.3\ s = 876{,}500$

a. $s = 876{,}500 \div 970.3 = 903$ lb flashing to steam or 18.06 per cent.

$5{,}000 - 903 = 4{,}097$ lb remaining water or 81.94 per cent.

b. Volume of steam = $903 \times 26.8 = 24{,}200$ cu ft.
Since 1 lb of steam at 14.7 psia has a volume of 26.80 cu ft.

c. Volume of water = $903 \times 0.0184 = 16.6$ cu ft
Since 1 lb of water at 200 psia has a volume of 0.0184 cu ft.

d. Volumetric ratio of water to steam is 1 to 1460.

Using ratio and proportion a much simpler solution can be obtained by taking the difference in the enthalpy of the liquids involved, thus:

$5{,}000 : 970.3 :: X : (355.4 - 180.1)$

$$X = \frac{5{,}000 \times 175.3}{97\ .3} = 903 \text{ lb of water flashed to steam. Ans.}$$

Consider the resulting situation caused by the tank explosion in a room 40 ft by 40 ft by 15.1 ft (24,200 cu ft) and the instantaneous release of 24,200 cu ft of steam. If the room is air-tight, the pressure will double or be $2 \times 14.7 = 29.4$ psi in the room and 14.7 psi (atmospheric pressure) outside. The difference in pressure of 14.7 psi or 2,117 #sf (pounds per square foot), which is over a ton, will be acting in all directions. It will push the walls out and the ceilings up. Of course, open windows and doors will lessen the effect but the above example is a rough estimate and shows clearly why hot water and steam explosions are so dangerous.

Let us now consider the explosion of a steam drum 48 in. in diameter by 14 ft 6 in. long, operating at 200 psia. The volume of the drum is $4 \times 4 \times 0.7854 \times 14.5 = 184$ cu ft. The lower half of the drum is filled with 5,000 lb of water or 92 cu ft and the upper half with 92 cu ft of dry saturated steam. Steam at 200 psia has a volume of 2.288 cu ft per lb and $92 \div 2.288$ equals 40 lb of steam.

The total heat available consists of:

$5{,}000 \times 175.3 = 876{,}500$ Btu in the water above 212 F
$40 \times 1018.3 = 40{,}730$ Btu in the steam above 212 F
Total = 917,230 Btu for flashing

$917{,}230 \div 970.3 = 945$ pounds flashing to steam or 18.90 per cent.
$5{,}000 - 945 = 4055$ pounds remaining water or 81.10 per cent.

This example proves that there is far more heat available for flashing in a cubic foot of water than in a cubic foot of steam when both are in the same vessel and under the same pressure. The volume in this case is $945 \times 26.8 = 25{,}300$ cu ft, or only 1,100 cu ft more due to the 92 cu ft of steam at the original pressure of 200 psia, while the 5,000 lb of water furnished 24,200 cu ft of steam at atmospheric pressure of 14.7 psia.

Annual Wisconsin Power Conference, June 11, 12, 13 at Milwaukee

ONCE again the Annual Wisconsin Power Conference and Exposition will be held at the Schroeder Hotel, Milwaukee, Wisc., June 11, 12, and 13, 1952. It is sponsored by the Associate Engineers and Supplymen of Wisconsin. Following is the preliminary program as of March 6:

Wednesday, June 11

10:00 A.M. *Convene*

10:15 A.M. *Plant Safety and Protection*
Don Barnes has contacted a representative of Travelers Insurance Co. The next desired action is to have a meeting of this representative with Charley Gelhaar to decide on scope of talk and need for a second speaker for that morning.

2:00 P.M. *State and Municipal Building & Electrical Codes*
R. C. Johnson, President, Siesel Construction Co., has agreed to talk on the general scope of codes and also on the state law requiring registration of architects and engineers.
George M. Kuetemeyer, Bldg. Inspector's Office, City Hall, Milwaukee, has agreed to talk on the building code.
George Andrae of the Herman Andrae Co. of Milwaukee has agreed to talk on the electrical code.

Thursday, June 12

10:00 A.M. *Fuels and Combustion*
The Long Range Fuel Supply Picture — Nyle Austin of Marathon Corp. is to furnish a speaker on this subject.
Fly Ash Handling and Reinjection — Mr. Wagner, Vice President in Charge of Engineering of Detroit Stoker Co., has agreed to talk on this subject.

2:00 P.M. *Industrial Wastes*
Ray Jolley, Consolidated Water Power & Paper Co., Wisconsin Rapids, has agreed to talk on burning of calcium base and ammonium base sulphite waste liquor under a boiler.
Mr. Hieseck of the Milwaukee County Sewage Commission has agreed to talk on disposal of general industrial wastes, other than paper mill wastes.

Friday, June 13

10:00 A.M. *Power Plant Records and Operation*
Jess Zibell, Plant Engineer, International Harvester Co., Milwaukee, has been requested to talk on maintenance records and a preventive maintenance program.
R. H. Langer, Chief Engineer, Miller Brewing Co., has agreed to talk on refrigeration insulation materials.
H. F. Luedtke, Industrial Division, Johns-Manville Sales Corp., Milwaukee, will furnish a speaker on insulating materials for temperature range of 250–800 F.

Full information about the conference may be obtained from Wm. C. Dudley, publicity chairman or Kerwin W. Knoelk, secretary, Route 5, Box 122, Waukesha, Wisc. or from George W. Chipley, 4854 N. Idlewild Ave., Milwaukee 11, Wisc.

Why They Didn't Need New Boilers—But Put 'Em In Anyway

Here is a case where an additional 1500 hp in boilers was asked for and installed, despite the author's report of inefficient operating practices such as a lack of any boiler instruments, dumping of hot condensate, uninsulated steam lines . . . New boiler capacity is often authorized when in fact existing facilities, if properly maintained and efficiently operated, could meet new steam demands easily

By C. T. BAKER
Consulting Engineer

AT TIMES it is difficult to understand reasoning behind certain decisions to invest additional funds in plant capacity, when facts show conclusively that added burdens to capital structures are unwarranted and even economically unsound.

In several instances I can recall where boiler capacity was added because the owners were convinced it was necessary, since loss in factory output was the result of insufficient steam supply. This was true, but only because the existing boiler plants had never been properly maintained or efficiently operated, making it impossible for them to produce steam at intended capacities.

In one case, a 150-hp hrt boiler was installed to supply additional steam to a small textile mill. Some months later, a new chief engineer began looking around to find out why the new boiler was needed. Among the reasons he discovered was that hot condensate from the majority of steam traps was dumped overboard. Notwithstanding that there was ample waste heat available to raise the temperature of the water in the open type feedwater heater to 200 F or more. The temperature was actually only 100 to 105 F when the water reached the boiler. Using a portable CO_2 machine, which he owned, the new engineer measured an average of 8 per cent CO_2 in the stack up-take. Within just a few months, the whole situation was improved and the new boiler was no longer needed.

An Additional 1500 hp Or Not?

But to get to the principal case in question — a certain railroad operated a large locomotive repair shop. This shop consisted of a number of widely scattered buildings, most of which required steam in considerable quantities. They were supplied from a central boiler plant consisting of 4 stoker-fired watertube boilers, totaling 898 hp.

According to information furnished me at the time of the survey, daily boiler capacity on the line during the month of greatest steam demand varied from a low of 374 hp to a high of 898 hp. However, the figure for the greatest demand was on *one* day only. The average for the other 30 days of this particular month was 658 rated hp on the line.

The engineering department had requested permission to purchase three 500-hp oil-fired boilers, to be self-contained steam generators that were to be fully automatic. Now, the question raised was, "Does the situation really call for installation of a 1500 hp addition to the boiler plant?"

Some very interesting facts were brought to light by the survey I was asked to undertake.

Results of Survey Enlightening

Principal factors which influenced the operation of the existing boilers can be summarized as follows:

1. There were absolutely no instruments installed, not even a draft gage, to guide the operating personnel in the operation and management of the boilers.

2. It was impossible to heat boiler feedwater in the open type feedwater heater above 145 F. Reason: the distance between the center line of the suction inlet of the feed pump and the suction outlet of the feedwater heater was only 30-in. Actual operating experience had shown that if the feedwater temperature was allowed to exceed 145 F, the feed pump would become steam bound due to evaporation of water at the suction inlet, brought about by reduction in absolute pressure of the water at this point. It was recommended that this heater be raised to a minimum height of 6 ft above the pump.

3. Hot condensate from several steam traps in, and adjacent to, the boiler room was being dumped overboard, when it should have been returned to the feedwater heater for re-use. A check on methods of condensate disposal at other points in the group of buildings revealed that all of it was being dumped overboard. It takes no great stretch of the imagination to understand what this method of condensate disposal represented in waste of fuel and city water.

4. There were heavy scale accumulations on the water side of the boiler tubes and heavy accumulations of soot and fly ash on their fire side. None of the boilers were provided with tube blowing equipment to prevent soot and fly ash from accumulating.

5. Breeching between the smoke stack and boilers was approximately half filled with fly ash. This interfered with normal operation of the stokers and at times produced smoke around the boiler fronts.

125 lb Steam Line Not Insulated

6. A 4-in. diameter line carrying steam a distance of 1700 ft at 125 lb pressure was not insulated. Drop in pressure between the steam header connecting the boilers and the round house where the line terminated, depending upon steam demands, varied from 45 to 56 lb.

7. One large repair shop was heated by 18 suspended type heaters, each rated at 126,564 Btu per hr, with steam at 15 lb and 60 F entering air. Condensate from these units was dumped overboard.

8. There were a total of 5 steam hammers in use, with cylinder sizes ranging from 7¼ x 24-in. to 15⅝ x 40-in. Steam supply lines connecting with the principal main in the building were 1½ and 3-in. in diameter. None of these were insulated. Steam supply to the building housing the steam hammers was under ground and not insulated.

9. In this plant there were 7 solution heating tanks, each fitted with a 2-in. steam coil used for cleaning engine and car trucks, etc. Largest of these tanks was 24 ft long by 12 ft 6-in. wide by 7 ft deep; the smallest was 12 ft long by 4 ft 6-in. wide by 43-in. deep. All tanks were fitted with 2-in. pipe coils, ranging from 10 to 20 ft in length, 6-pipe high. No traps had been provided to drain the condensate from these coils. Drainage was controlled by the partial opening of a valve on the outlet leg of each coil. The condensate, of course, went to the sewer. It was recommended that each coil be equipped with a condensate trap, and that the pipeline between the boiler plant and this building be insulated. Also recommended was automatic temperature control of the solution in each tank by means of a thermostat and a modulating steam valve.

These tanks were all located outdoors and all were exposed. No insulation had been used to reduce heat losses from such exposure.

When this evidence was presented in the form of an engineering report, which showed that the existing boiler capacity would serve well in the future, I was complimented and paid in full.

Then they purchased 1500 hp in new boilers!

Having Boiler Handhole Gasket Trouble?

Here's what some utilities are doing about boiler handhole gasket trouble according to a questionnaire which was circulated by the Corrosion Section, Power Station Subcommittee, Prime Movers Committee, of the Edison Electric Institute—

A QUESTIONNAIRE was circulated to utilities recently to determine what they were doing about boiler-gasket failures. It asked about failures due to gasket corrosion, and also those due to handhole seats and cap corrosion.

Thirty replies were received, representing nearly 50 steam plants and 200 boilers.

In general, those reporting attributed failure to the type of gasket and the conditions under which it was used, not to a specific type of boiler. Gasket failure occurred on radiant, convection, and combination types of superheaters on boilers operating over wide ranges of pressure and output.

The type of gasket used was generally that recommended by the equipment manufacturer. This was especially true of new installations but also applied in a considerable degree to older ones. Many companies have instituted experimental studies of their own, to obtain information of the type of gaskets best suited to particular services.

Although 19 companies reported that they acid-cleaned boilers, only two gave this procedure as a reason for gasket failure. One company believed that destruction of the asbestos lining of filled gaskets was caused by the fluoride used in the acid-cleaning solution.

Failures were reported by about one-half of the filled gasket users. The jackets of these gaskets were made of copper, monel, and both mild and stainless steel. Copper and stainless steel jackets appeared to give better service than the others. Plain monel gaskets had about the same record as the filled gaskets.

Solid gaskets of copper, Armco iron, and Rema alloy were satisfactory in about two-thirds of the cases. Plated gaskets were used successfully by two companies, cadmium plating by one, and zinc by another.

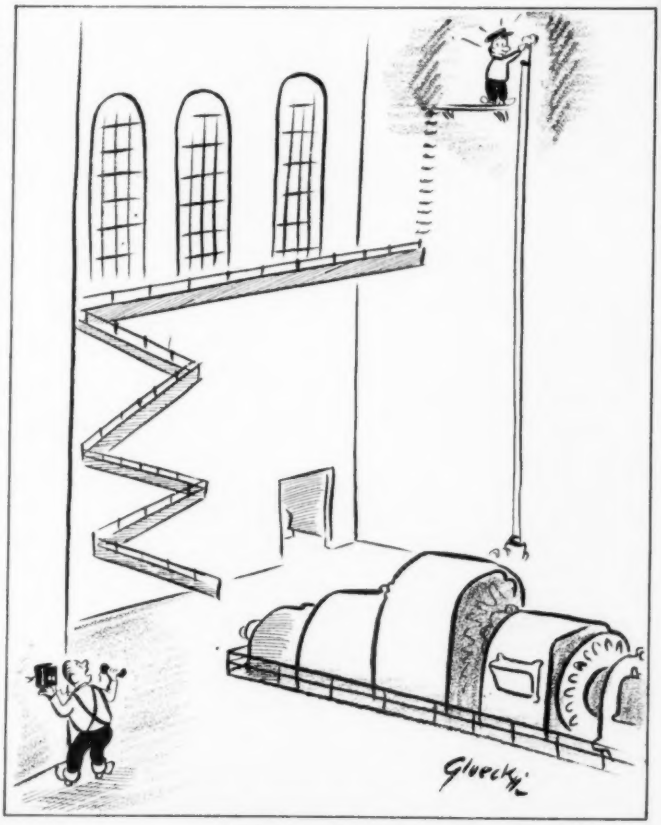
Failures were attributed simply to corrosion in about one-half of the cases. However, in two cases the answer was further qualified by giving as the cause of corrosion the contact of dissimilar metals. One-quarter of the failures were reported as caused by steam- and water-cutting. A few companies lessened their failures by exercising more care than they formerly did in seating the gaskets and tightening cap nuts.

In contrast to the rather definite statements regarding the failure of gaskets, the 30 questionnaires which were returned did not give very conclusive information on the subject of corrosion of handhole seats and caps. Sixteen of those answering reported some type of corrosion. However, four of them definitely attributed the attack to electrolytic corrosion resulting from the contact of the boiler steel with dissimilar gasket metal.

In two cases corrosion was blamed on flue dust around the outside of handhole caps. In one of these cases, the explanation was that corrosion was caused by continuous wetting of acid flue-dust by steam leakage.

In three cases, acid-cleaning was blamed. One of these was the case of a boiler fitted with stainless gaskets which showed pitting on the unmachined surfaces of handhole caps after acid-cleaning. In both of the other cases, the boiler had been cleaned with 10 per cent hydrochloric acid, which is a higher concentration than generally recommended. One of these boilers had Armco gaskets, the other steel, asbestos filled. The remainder of the reports of handhole cap and seat corrosion attributed the attack to pitting or wastage.

The analyses of the replies to this questionnaire did not indicate any clear-cut solution to the problem of gasket failure or gasket bearing surface corrosion. They did show that proper placement of the gaskets and caps helps to prevent failure. They revealed that caution should be exercised when replacing gaskets with those which are widely dissimilar to the boiler metal. Flexitallic gaskets appeared to be highly satisfactory, and in several cases it was reported that a change to that type of gasket had stopped gasket failures.



"It's for you — Naturally!"

Questions and Answers

Question No. 496

HOW SHOULD HE HOOK UP SYNCHRONIZING TRANSFORMER?

Two separate systems with two 110-v synchronizing transformers are involved as shown in the diagram: one transformer from the grounded wye side of a 12-kv oil circuit breaker, the other on an ungrounded delta side of the same switch.

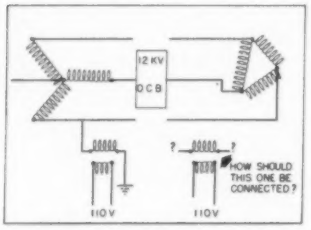


Diagram by H.H.C. showing wye and delta connected generators and synchronizing transformers. How should transformer on delta side be connected so grounding on delta side will not affect it?

The problem is to hook up the synchronizing transformer on the delta side so that, with the circuit breaker either opened or closed, the transformer will not suffer in the event of a ground on the delta system.

California H. H. C.

Question No. 497

SHOULD HE INSTALL ADDITIONAL DEAERATOR?

AT PRESENT we have a deaerator of 80,000 lb per hr capacity. We intend to increase our steam consumption to 120,000 lb per hr. Could we install an additional deaerator or would we have to install a larger single deaerator? What capacity deaerator would be needed to meet the new demand? How many pounds of steam would be required per hr for the deaerator?

We are going to carry 45 psi on inlet of the steam reducing valve, and the steam line to the heater will be about 100 ft long with four ells. What size pipe would be required to supply the heater? What size reducing valve would be required?

The following data is applicable: 120,000 lb steam per hr; 5.3 psi in deaerator; temperature of feedwater, 228 F; temperature of make-up water, 60 F; temperature of condensate, 200 F; with 40 per cent make-up and 60 per cent condensate.

New Jersey J. G. D.

Editor's Note: After once determining whether to install an additional or a larger single deaerator, the answers to most of J. G. D.'s questions on deaerator performance can be found in the article, Graph Your Deaerator Heat Balance, POWER ENGINEERING, December 1951 issue.

Answer No. 492

SHOULD HE BUILD SEPARATE HEATING PLANTS?

I WOULD arrange your 50 lb, 10-in. steam line to form a loop system. Assuming that the 50 lb steam is reduced to about 10 lb for building heating, 10 lb of steam at 193.21 F has 1143.1 heat units. This is a lot of heat.

H. V. Carpenter's Steam and Pipe Size Chart will help you a great deal.

Brunswick, Ga. B. D. RILEY

No, Says Wenig

YOU STATE that you have sufficient steam generating capacity for the system as is, plus the additional capacity needed for the two new buildings. It would definitely be more advantageous and economical to add additional underground steam lines. This addition, if properly installed, can be kept to a minimum and made to assist the present overloaded lines in delivery of steam of proper pressure and temperature to all the buildings.

I would suggest the use of prefabricated underground pipe lines (both supply and return if needed). This pipe is furnished in 20 ft lengths and field joints are very easy to make.

Insofar as the layout is concerned, pipe size will, of course, have to be determined by conditions of pressures and volumes on the job. Run a high-pressure steam (boiler pressure) line, 250 psi, from the boiler room to one of the new buildings as in sketch. Also run a 50 psi line and a low pressure line for heating from the existing lines to this same building. You will have to add all necessary traps, checks, gauges and by-passes needed.

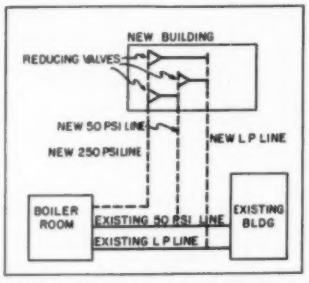


Diagram by Wenig showing how he would do it

Connect the 250 psi line through reducing valves to the 50 psi line and the low pressure line. If you wish, use a reducing valve from the 50 psi line to the low pressure line. All this can be done in the corner of the basement in one of the new buildings, with sufficient room to permit easy maintenance of all valves.

I believe the above plan, with slight modification, will be your best bet.

Brooklyn, N. Y. ARTHUR J. WENIG

Answer No. 491

HOW HIGH CAN TURBINE EFFICIENCY GO?

IN THE JANUARY ISSUE, T. D. asked what is the highest possible over-all efficiency obtainable in a modern steam turbine, disregarding economic questions and using as many feedwater heaters as desired?

The question was also asked in a recent issue of *Coal to Kilowatts*, published by The Detroit Edison Co. and the following answer was given in that magazine by Dick Hart.

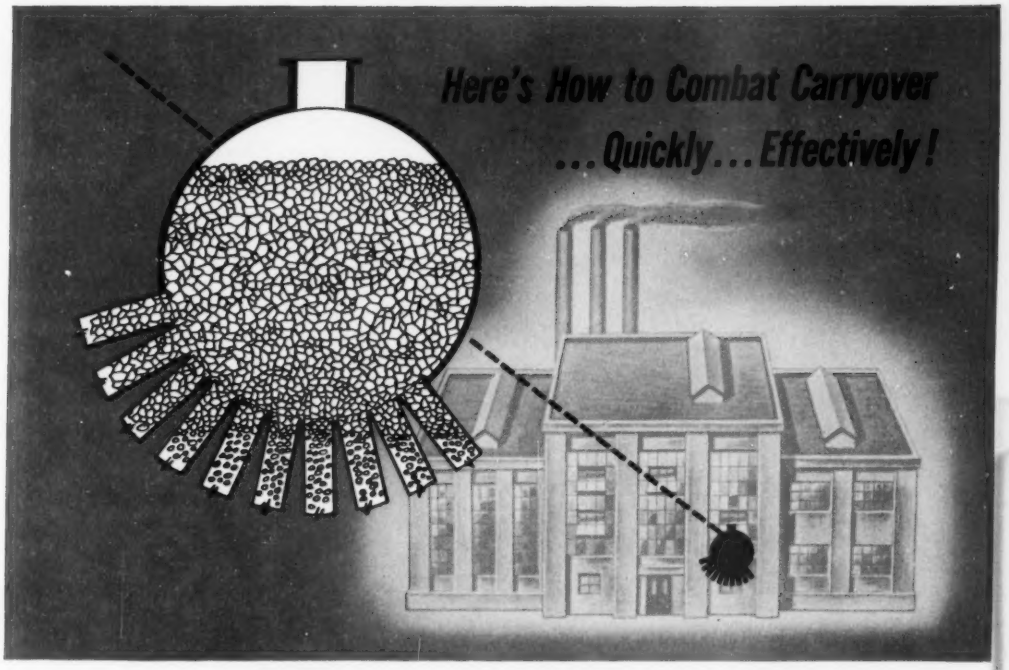
Comment by Hart

In answering this common question a theoretical regenerative cycle has been assumed in which steam is expanded through a modern steam turbine to one inch mercury back pressure. A portion of this steam is extracted for heating feedwater to the saturation temperature corresponding to throttle pressure in an infinite number of heaters. In the column headed *Modern Turbine* the only departure from a theoretical cycle involves the application of modern over-all turbine-generator efficiencies.

Editor's Note: Note that in the table below the efficiencies values are given for an infinite number of feedwater heaters. It will be interesting to compare these values with the data on heat rates of actual turbines given in the article—How to Figure Heat Rates of Big Modern Turbines, March issue, page 64.

Table by Hart showing ideal and actual turbine efficiencies for steam conditions of recent units

Throttle Conditions, Pressure and Temperature	Turbine Heat Rate Btu per Gross Kwh		Turbine Cycle Efficiency, per cent	
	Modern Turbine	Ideal Turbine	Modern Turbine	Ideal Turbine
850 psig, 900 F (Marysville conditions)	8884	7214	38.4	47.3
1300 psig, 950 F (Trenton Extension Conditions also Conners Creek Ext.)	8177	6836	41.7	49.9
1800 psig, 1000 F, 1000 F reheat (St. Clair Conditions)	7250	6184	47.1	55.2
2300 psig, 1100 F, 1050 F reheat (Present day maximum)	6891	5878	49.5	58.1



One of the most common sources of trouble and expense in steam power systems is carryover and excessive blowdown. But these troublesome conditions, even when extreme, can easily be overcome by the proper application of anti-foam agents.

To illustrate the point, in one plant operating with 100% cold lime soda softened make-up water, boiler water concentrations above 7,500 ppm caused severe carryover with normal boiler water levels. With water level two inches above normal, carryover occurred at 6,500 ppm boiler water solids. It was necessary that boiler water concentrations be restricted by the maintenance of a 16 to 20% rate of blowdown.

Application of anti-foam agents to this problem permitted doubling the boiler water concentrations and reduced blowdown to the range of 8-10%. In addition, heat savings in blowdown totaled more than $30.00 per day!

In this, as in many other cases, the use of anti-foam agents permits efficient plant operation with a minimum blowdown rate.

Why not ask a Betz Engineer to tell you how anti-foam agents can save *you* time, money and effort in *your* plant? Ask him too, about the complete Betz *Specialized* Water Conditioning Service tailor-made to your needs.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

Betz Technical Paper No. 115, "Carryover Prevention with Anti-Foam Agents" is free for the asking. Write today.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

Highlight of American Power Conference at Chicago was ceremony in which Illinois Institute of Technology conferred degree of Doctor of Engineering on Alex D. Bailey, former president, ASME, and retiring vice president of Commonwealth Edison Co. Left to right: Honorable Everett M. Dirksen, U. S. Senator from Illinois; James J. Nance, President, Hot Point, Inc.; Dr. John T. Rettaliata, President, Illinois Institute of Technology; Alex D. Bailey; Dean of Engineering, William A. Lewis, IIT, putting doctor's hood on Mr. Bailey; and Rear Admiral F. T. Old, USN, Commandant Ninth Naval District. Scene is in Hotel Sherman, Chicago, Ill.

First American Power Conference Carries On High Standards of MPC

Under new name, American Power Conference (formerly called Midwest Power Conference) holds first annual gathering at Hotel Sherman, Chicago, Ill., March 26, 27 and 28 . . . Technical sessions covered important new developments in central station boilers and turbines, high voltage electrical equipment and transmission, industrial steam and power development, power plant auxiliaries, fuels and combustion, hydro power, water technology, gas turbine developments . . . Inspiring and informative discussion of social and economic problems of the day by leading industrialists

FOR THE FIRST annual meeting of the American Power Conference, formerly known as the Midwest Power Conference, held at Chicago, March 26, 27 and 28, approximately 2700 engineers and executives from all over the country were registered. Half of these were presidents, vice presidents and engineers of various utility companies throughout the country, and the remainder were from various segments of industry.

Outstanding papers were delivered on all phases of central station and utility power plant design and operation, as well as on a number of the social and economic problems of the day. One of the highlights of the conference was the ceremony shown in the accompanying illustration, in which the Honorary Degree of Doctor of Engineering was conferred upon Alex D. Bailey, recently retired vice president of Commonwealth Edison Co. and former president of the ASME, for his many contributions to the advancement of engineering during his 48 years of service with the Edison Co. in Chicago. This ceremony took place at the All Engineers Dinner on March 27.

Speaker at this dinner was the Honorable Everett M. Dirksen, United States Senator from Illinois. He reviewed the contribution of the engineering profession to society and outlined the background against which the centennial celebration of the founding of the American Society of Civil Engineers will be held this year.

In design of large central station boilers, provision for use of a wide variety of fuels was stressed by two speakers. H. B. Wallace, Jr., of Foster Wheeler Corp. pointed out that despite the persistent deterioration in the quality of solid and liquid fuels

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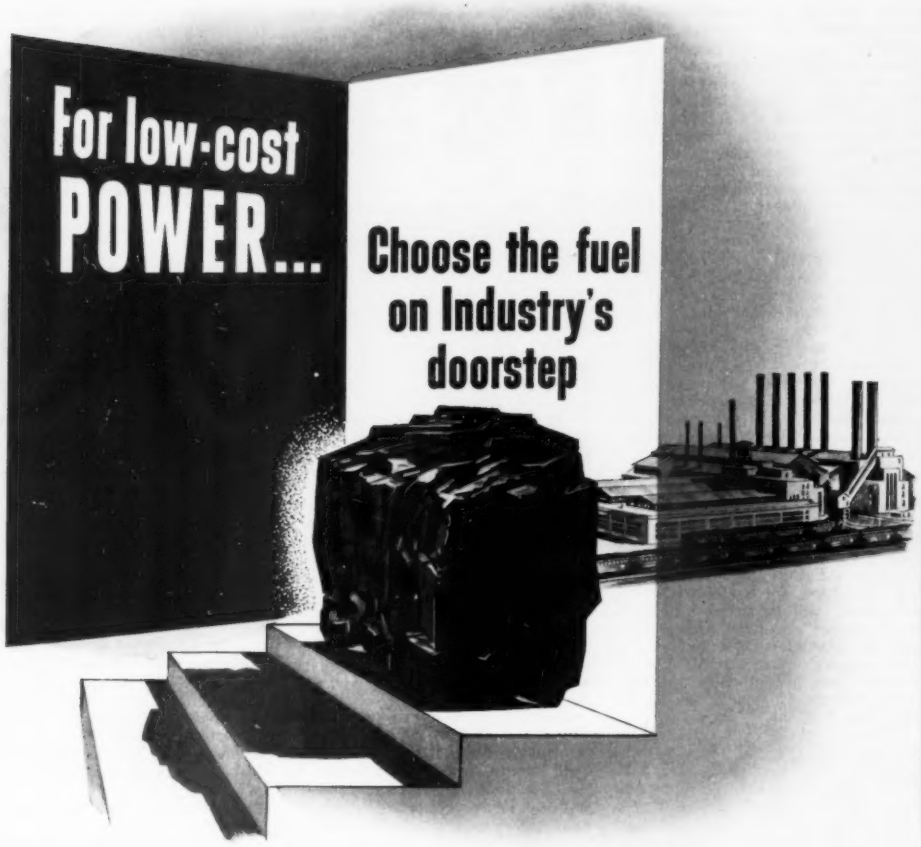

Coal is where you find it. Fortunately, however, a large share of the nation's operating Bituminous mines are located in Baltimore & Ohio territory—*economically accessible to America's great industrial plants.* The Bituminous mined here—practically on Industry's doorstep—is of excellent quality and in wide variety; whatever your specific need, there are B&O coals to meet it. Furthermore, the supply is *inexhaustible*—you can count on an *unlimited* reserve of B&O Bituminous, even in emergencies, for centuries to come.

When you consider fuel, consider cost—dependability of service—*accessibility.* You'll choose the Bituminous mined on the B&O. For advice, *ask our man!*

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BALTIMORE & OHIO RAILROAD

Constantly *doing things*—better!

within the last 15 years, successful furnace design has been carried out, using very conservative furnace heat absorption rates, proper distribution of steam and water cooled surfaces, multi-furnace designs and the like. He discussed some of the problems of reheat, including multiple reheating, gave details of dual circulation boilers, discussed forced circulation designs as contrasted with natural circulation designs, and showed the need in some cases for quick starting procedures.

W. H. Rowand of the Babcock & Wilcox Co. also discussed the importance of considering the types and kinds of fuels in determining boiler design, the problem of steam temperature control, the influence of feedwater temperature, flue gas losses, control of the boiler and influence of load variations. Both speakers discussed pressurized furnaces, influence of outdoor design and the like.

Steam Turbines

Modern steam turbines for central station service require careful control, said Charles F. Wilson of Allis-Chalmers Mfg. Co. Controls are required for starting and stopping the machine, for governing and maintaining regulation, for turbine auxiliary equipment and for safety and automatic protection of the turbine. The speaker showed control diagrams of his company's machines. Most of the controls are hydraulically operated, using turbine oil at 150 psi as the operating medium.

Thermal efficiency and design of high-temperature and reheat turbine generator units were covered by J. R. Carlson of Westinghouse Electric Corp. He reviewed and tabulated heat rates, steam conditions, and other data for modern, large high-pressure high-temperature turbine generators, taking data from his previous ASME paper on Thermal Performance of Modern Turbines; see POWER ENGINEERING, March 1952, page 64. He discussed details of the two-casing tandem compound reheat turbine. He also emphasized the rapid development of the 3600-rpm turbine, stating that the 3600-rpm turbines may soon supersede the 1800-rpm turbines for ratings through 200,000 kw.

Design features of the Oak Creek Station of Wisconsin Electric Power Co. were given by O. J. Stallkamp, assistant chief engineer of the company. This plant, now under construction on the west shore of Lake Michigan 10 miles south of Milwaukee, will have 4 generating units, each rated 120,000 kw, the first two going into operation early in 1953. Some features of Oak Creek Station, such as radiant superheaters, radiant reheaters, bin and feeder firing of coal, single boiler and turbine are similar to those at Port Washington and Lakeside Stations of the company. Other features are use of cross-compound turbines, controlled circulation boilers, vertical pumps, a pressurized circulating water tunnel and complete centralized control.

Industrial Power Development

V. F. Estcourt of Pacific Gas and Electric Co. described in detail some of the problems in supplying steam and power to a lumber mill at Eureka, Calif., and to three oil refineries near San Francisco. The lumber mill is supplied with an average of about 50,000,000 lb of steam a year at 170 psi and about 6,000,000 kwh at 2400 v. For the three refineries at Avon, Oleum and Martinez, Pacific Gas and Electric system supplies all process steam and electric power, ranging in amounts up to 325,000 lb per hr of steam and 15,000 kw of electricity.

Development and application of water tube package steam generators for industrial purposes were discussed by N. O. Kirkby of Vapor Heating Corp. He described generators of the type shown in POWER ENGINEERING, February 1952 issue, page 64.

Power Plant Auxiliary Equipment

Effect of sudden load fluctuations on centrifugal boiler feed pumps was discussed by I. J. Karassik of Worthington Corp., George Bosworth of Bechtel Corp., and B. Schmid of Pacific Gas and Electric Co. An abstract of this paper will be published later.

Ben Ragland of American Blower Corp. discussed development of the variable speed fluid drive or hydraulic coupling, which has been applied to boiler feed pumps and forced- and induced-draft fans.

Considerations in design of industrial condensers were covered by G. H. Putnam of Ingersoll Rand Co. and condenser circulating pump intake model tests by W. W. Weltmer of Allis-Chalmers Mfg. Co. Mr. Weltmer described the model test flume and outlined some of the results obtained with it that have upset previous notions of intake design. He previously discussed some of these ideas in POWER ENGINEERING, June 1950.

Water Technology

Operating experience with the demineralizing plant of the Dow Chemical Co. was described by M. E. Brines, Assistant Superintendent of Power. When the company's installation of cyclone-fired steam generating units was first planned in 1949, it was found they would have to operate continuously on 100 per cent makeup, with minimum blowdown. Engineering studies determined that demineralization was economically feasible, using Lake Huron water as the raw water supply, and accordingly a complete demineralization plant was installed in two sections, the second going into operation in May 1950. The power plant and some of its details were described in our March 1949 issue.

Feedwater treatment in the Illinois State Institutions was reviewed by Russell W. Lane of the Illinois State Water Survey. He described the way in which a survey of each plant in the 40 institutions of the state was conducted, described sources of water obtained from surface supplies, wells and city water supplies, analyzed the characteristics of these waters, and explained that methods of treatment adopted are hot lime soda softening and sodium exchange, with or without subsequent acid treatment for alkalinity reduction. Internal treatment is being applied by several methods.

Fuels and Combustion

Use of lignite as a fuel for the Middle West was discussed by Alex Burr of the U. S. Bureau of Mines. A. D. Singh discussed the various methods of processing solid fuels to produce low-cost fuel and other liquid by-products. Further details will be given in a future issue. Elmer R. Kaiser of Bituminous Coal Research, Inc. told the conference of development of a new mining machine that cuts and loads coal underground without explosives. He predicted that the widely publicized gas turbine locomotive may soon be on the rails burning coal. One of the BCR projects now underway is the development of an automatic boiler for small industrial plants.

Gas Turbine Development

Progress Report on the L. D. C. coal-fired gas turbine locomotive now under test at Dunkirk, N. Y., was presented by J. I. Yellott and Peter R. Broadley of the Locomotive Development Committee. A full abstract of this paper will be found elsewhere in this issue.

Gas turbine power plant designs of various types were reviewed by T. J. Putz of Westinghouse Electric Corp.

Operating experiences with stationary gas turbines were reviewed by Paul R. Sidler of Brown Boveri Corp. After reviewing the various cycles being used, he discussed gas turbine units in operation, showing the data for 13 units operating at present.

Power Plant Noise

Unusually interesting to the Conference was the session on noise problems in power plants. W. F. Friend of Ebasco Services, Inc., outlined the causes of noise and the methods generally applicable for preventing it, or reducing it.

H. C. Hardy of Armour Research Foundation, outlined in detail how to determine design characteristics for noise control of power plants; details in a future issue.

Electrical Equipment

Of the most recent developments in the field of electrical power transmission and distribution, one of the most important is the recent trend towards using aluminum instead of copper as an electric power conductor. This was reported on by E. V. Sayles and C. E.

(Continued on page 99)

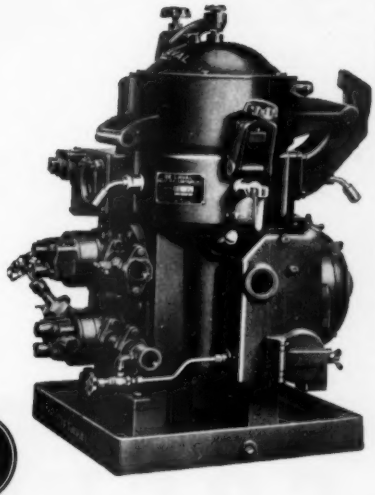
SUPPOSE WATER GOT IN YOUR OIL

--WHAT PRICE WOULD YOU PAY?

A De Laval Oil Purifier insures you against the trouble that water can cause in your turbine lube oil system. Any De Laval machine correctly selected for size in the first place has ample reserve capacity to take care of a sudden water condition. A De Laval is complete protection against water damage, whether due to the gradual infiltration of a few drops of moisture or to a serious leak.

Naturally a De Laval machine also throws out of the oil any solid contaminants that may be present. The result is that a De Laval centrifugal gives ***two-way*** protection — against ***water*** and against ***dirt***. Of the two contaminants, usually water spells the greatest degree of trouble.

The centrifuge alone is sufficient for complete oil purification but a filter may be added to remove fly ash after centrifugal force has taken out the harmful impurities.



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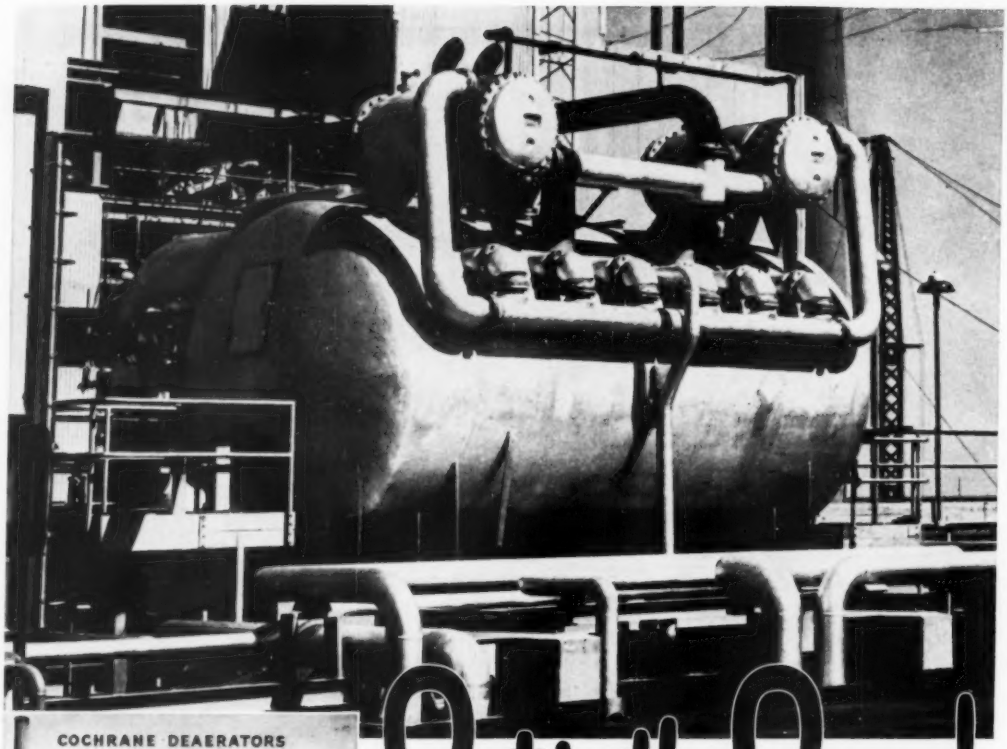

Out in the Open!

AT PACIFIC GAS & ELECTRIC COMPANY'S new Contra Costa steam plant at Antioch, California, three COCHRANE DEAERATORS deaerate the boiler feed for six 475,000 lbs./hr. boilers.

Cochrane Deaerators at P. G. & E.'s Contra Costa Plant

THE DEAERATORS are of the Cochrane direct contact tray type with 1,176,870 lbs./hr. maximum flow, and 6300 gal. storage capacity. Each deaerator has two vent condensers and all three deaerators are mounted on the auxiliary bay roof, as shown in the large photo above and in the inset panel. In the heating cycle, the Cochrane Deaerators function after the No. 5 closed heater at a designed operating pressure of 5 psig.

These deaerators are three of the fifteen Cochrane Deaerators purchased by P. G. and E., installed or now on order. COCHRANE DEAERATORS whether tray-type, atomizing type or multi-stage type, are available for any deaerating need, for any size plant and for any location or space requirement. Cochrane Publication No. 3005 will be gladly mailed on request. Specific problems are also welcomed.

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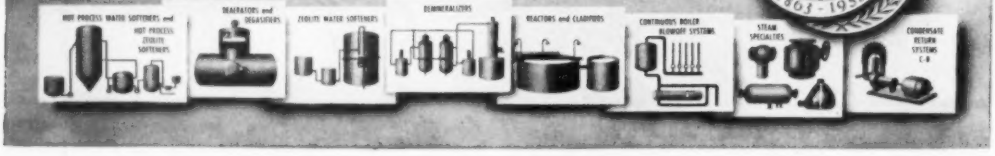
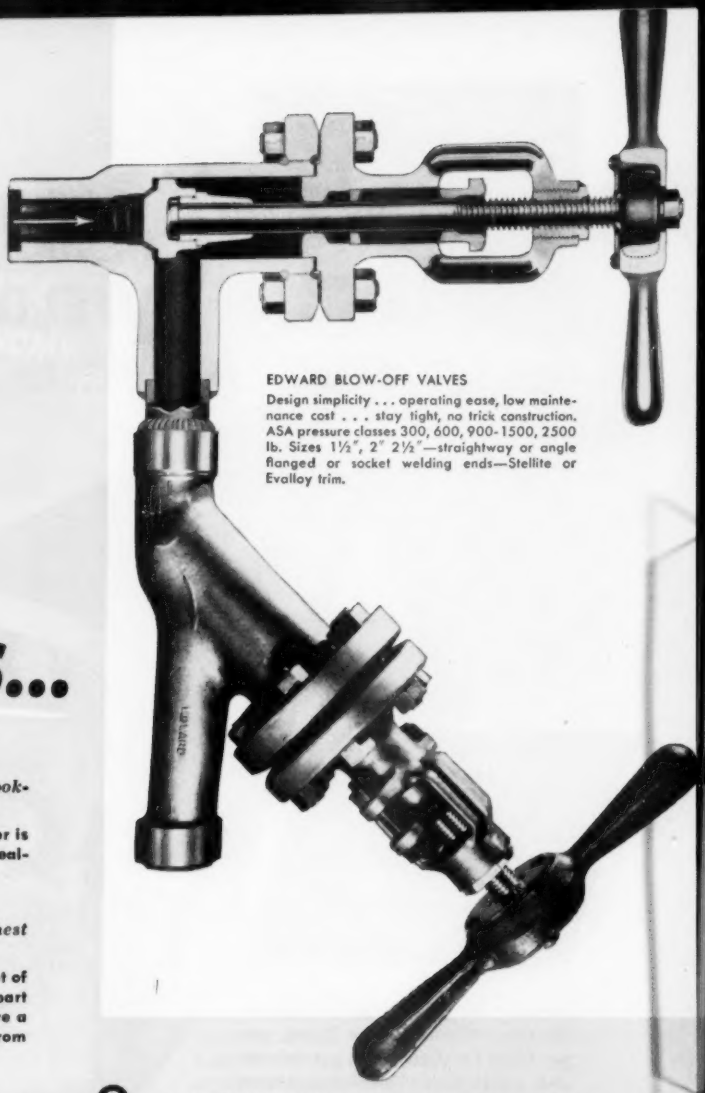


Before You Buy Blow-off Valves ASK THESE QUESTIONS...



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Design simplicity . . . operating ease, low maintenance cost . . . stay tight, no trick construction. ASA pressure classes 300, 600, 900-1500, 2500 lb. Sizes 1½", 2" 2½"—straightway or angle flanged or socket welding ends—Stellite or Evalloy trim.

Q. *In a tandem blow-off valve hook-up, will both valves stay tight?*

With Edward, the valve nearest the boiler is the same design as its mate. Both are "sealing" valves.

Q. *Is the packing out of the highest temperature zone?*

Edward blow-off valves have only one set of packing, for the stem is the only working part that needs to be packed. Packing is above a condensate cooling chamber, removed from highest line temperatures.

Q. *Do the valves have backseats, so that packing can be replaced in service?*

With Edward, the answer is "yes".

Q. *Can leakage start through bonnet misalignment?*

Not with Edward blow-off valves. The Edward one-piece bonnet has no yoke posts to permit distortion.

Q. *Are parts of both blow-off valves interchangeable?*

Edward answers "yes". And with fewer working parts Edward blow-off valves need less maintenance. If part replacement is necessary, repairs are easier and less expensive with Edward.

Q. *Can the seat and disk bind together?*

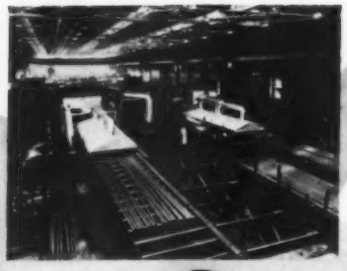
Not Edward, because the disk lifts off the seat on operating instead of grinding against it. There is no sleeve to gall against the seat.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
220 WEST 144TH STREET
EAST CHICAGO, INDIANA

Another Product

Edward built the first steel blow-off valves. Installation records in America's major steam plants for nearly 50 years tell this story—no blow-off valves are better designed for year-in, year-out service with low maintenance. Write for Edward blow-off valve catalog, No. 12-D.



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...for 5-star satisfaction*

★ quality
★ dependability
★ economy
★ uniformity
★ long service

When you specify B&W Electric-Resistance-Welded Boiler Tubes, you get 5-Star Satisfaction that goes beyond code requirements—plus values derived from metallurgically controlled materials, manufacturing precision, verified uniformity and meticulous inspection for perfection. Find out from Mr. Tubes—your B&W representative—or your local distributor what B&W 5-Star Satisfaction can mean to you, or write for information on B&W ERW Boiler Tubes.

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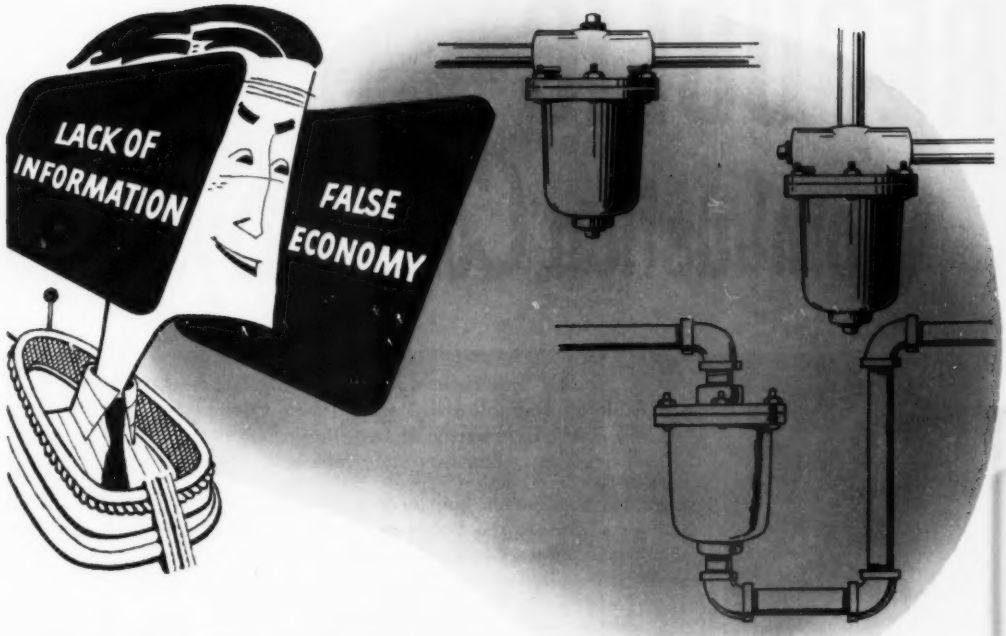

BEFORE BUYING STEAM TRAPS
REMOVE THE BLINDERS

Before you install new Steam Traps or replace worn out traps, be sure you are not bothered by "lack of information" or "false economy" blinders. Many replacement trap buyers *are* hindered by false economy . . . believing it cheaper to continue using their present old style trap. Remove all trap buying blinders/ . . . send for your copy of "Solving Steam Trap Problems" today. Check the economy features of replacing present systems with Anderson Super-Silvertop Steam Traps. You'll find they cost no more than most ordinary traps . . . yet Super-Silvertop Steam Traps can be serviced without removing the trap from the line, saving 30 minutes service time. Note too, that the valve and seat are made of longer lasting Anderloy* alloy . . . with the bucket guided on a center tube, eliminating bucket damage and costly repair. 3 pipe connections in the head allow the trap to be installed straight-in-line or as an elbow saving up to 50 minutes installation time and as many as 7 fittings.

For the complete story on trap economy, be sure to mail the coupon for booklet today.

*Trade Mark Registered in U. S. Pat. Off.

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Gentlemen: Please send without obligation "Solving Steam Trap Problems."

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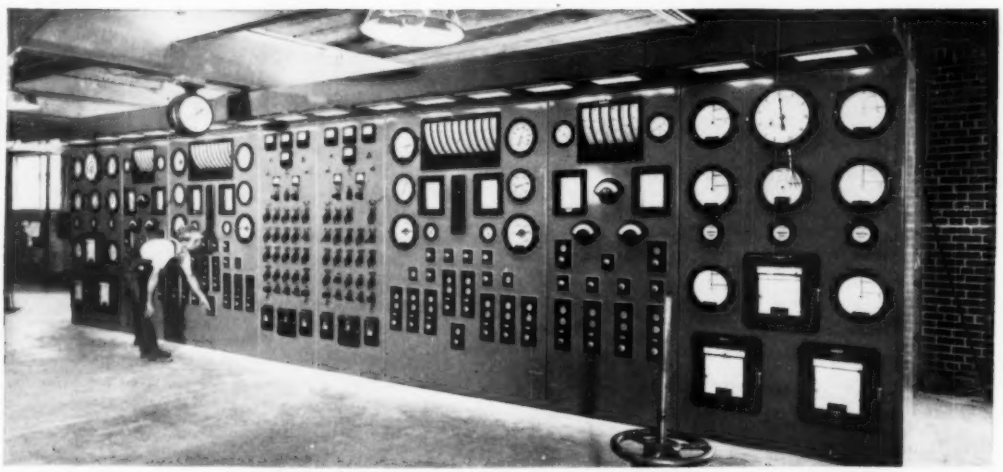
Combustion Control Systems

AN automatic combustion control system, as designed and built by Republic, will enable you to operate your boiler (or boilers) over a long period at test efficiencies regardless of variations in fuel, load and other operating factors.

Republic combustion control is a unified system controlling the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

Republic automatic combustion control systems, either pneumatic or hydraulic, are available for all sizes of boilers, all types of fuel firing, and load conditions and any arrangement of draft equipment. They are completely described in Data Book No. S-21—write for your copy.



PULVERIZED COAL
In this modern central station steam is generated in two 600,000 lbs. per hr. pulverized coal fired boilers operated by a Republic Combustion Control System.

REPUBLIC FLOW METERS CO.
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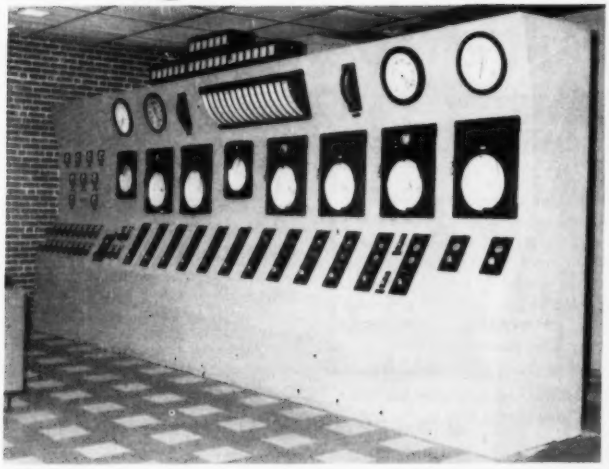
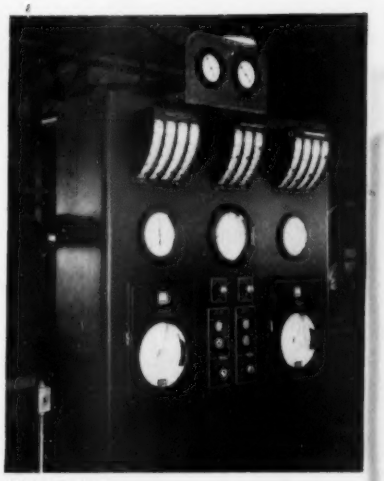
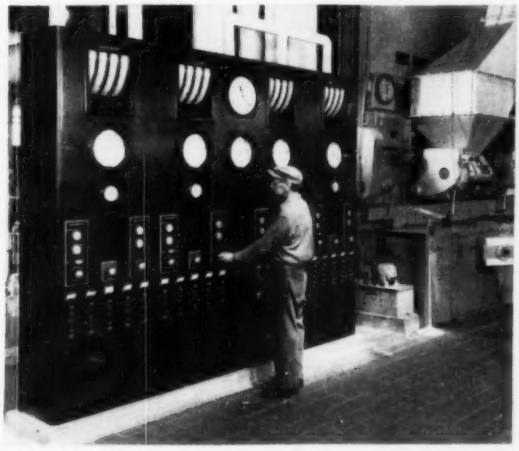
for { All Sizes of Boilers
All Types of Firing
All Arrangements of Draft
All Load Conditions



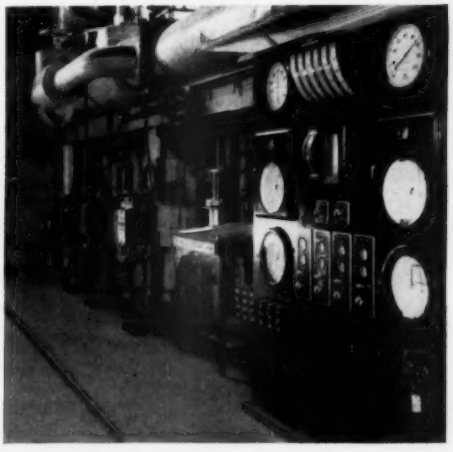
OIL FIRED
A typical Republic automatic boiler control and instrument installation in a large central station for the operation of a 450,000 lb. per hr. oil fired boiler.



MIXED GAS
Republic instrument and controls for two 50,000 lb. per hr. boilers burning mixed gas.



STOKER FIRED
The Republic combustion control and instrument panel for the automatic operation of four 80,000 lb. per hr. stoker fired boilers.



STOKER FIRED
In this modern industrial plant steam is generated in a 175,000 lb. per hr. stoker fired boiler operated by a Republic control system.

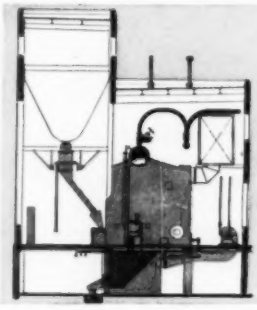
"74.2% MORE STEAM PER DOLLAR-

that's what this modern coal installation gives us at Perfection Stove Co.!"

says George I. Chittenden, consulting engineer for the Perfection Stove Company.

Perfection's old installation, if operating today, would generate 1,362 lbs. of steam per hour per dollar. The new plant produces 2,373 lbs. of steam per hour per dollar. Here's proof of the economy and efficiency of bituminous coal burned with modern equipment.

This view of Perfection Stove's new steam plant shows the coal elevator and ash silo. Coal is delivered through an under-track hopper, lifted by elevator to storage. A pneumatic system carries ashes to the silo.



This sectional drawing of the plant's boiler installation shows the coal bunker over the firing aisle. A weigh larry with dust-proof connection feeds coal to the stokers. The plant is clean and efficient—typical of the modern design that makes full use of coal's inherent advantages.

If you operate your own steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

● More and more consulting engineers are advising their clients that *bituminous* coal is the best buy for steam fuel. *Here's why:* Nearly everywhere coal yields more BTU's per dollar . . . modern combustion installations step up this inherent economy . . . up-to-date coal- and ash-handling systems cut labor costs to a minimum.

Tremendous reserves give coal a future dependability of supply no other fuel can offer. And to mine this coal, America has the world's most productive and efficient coal industry—making coal the one fuel most likely to remain reasonably stable in price.

If you're building or planning to modernize a steam plant, call in a competent consulting engineer. He'll show you how a modern coal installation can save you money and do a more efficient job, too!

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
WASHINGTON, D. C.

FOR HIGH EFFICIENCY ● *FOR LOW COST*

YOU CAN COUNT ON COAL!

POWER CONFERENCE

(*Continued from page 90*)

Topping of Consumers Power Co. They pointed out that because of the relative scarcity and high cost of copper, increased use will be made of aluminum. Although aluminum's conductivity and strength are lower than that of copper, still aluminum is very abundant and the lack of conductivity can be overcome by use of more metal. Mechanical strength can be secured by stranding aluminum with metals of greater strength.

On the Bonneville system of high voltage transmission of the Bonneville Power Administration, as reported by A. A. Osipovich and H. L. Rorden of that organization, every effort has been made during a period of rising cost, to minimize transmission costs, which represent a large part of total power cost. Developments adopted on the system include light steel towers, reduced insulation level, better circuit breaker performance, high speed reclosing, shunt static capacitors, use of large auto transformers, series capacitors, high-voltage low-capacity interruptors, high-voltage low-capacity substations, microwave communication and control and maintenance with circuits energized.

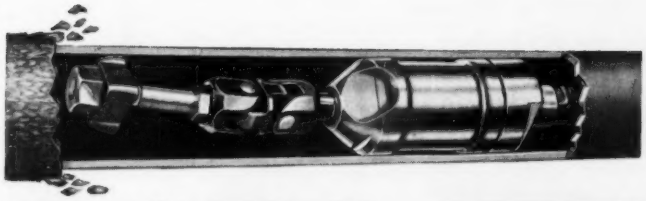
Power Industry Needs Vision

Philip Sporn, president of American Gas and Electric Service Corp., at a conference luncheon, urged fellow members of the power industry to use more long-range vision in their operations. By vision he does not mean an engineering-economic study or an engineering evaluation. These alone are a hindrance rather than a help, said Mr. Sporn. Without vision an engineer does not go to the root of the problem. You can't stop abruptly where the slide rule ceases to be useful. Vision in the power industry must include an understanding of social, economic and political fields to help the industry keep its own rate of growth and to enable it to serve the community in which it functions.

Power, said Mr. Sporn, has an extremely important role to play in the defense of the American system and in the acceptance of that system by people all over the world.

Pressly H. McCance, president, Duquesne Light Company, before a conference luncheon, reviewed the development of the electric utility industry, discussed the competition between the private and federally owned utility industries and, despite the problems and difficulties, predicted a very bright future.

The conference was conducted under the sponsorship of the Illinois Institute of Technology and all the major engineering colleges and universities of the Middle West, together with the co-operation of the representatives from the utility industry and various manufacturing industries. Conference Director is R. A. Budenholzer, and Conference Secretary is E. R. Whitehead, both of the Illinois Institute of Technology.



ROTOJET®

Cleans Fire Tubes ▸▸▸▸▸▸ FAST ▸▸▸▸▸▸▸

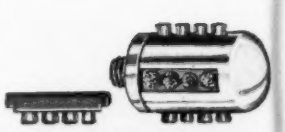
INSIDE and OUTSIDE

You can now clean fire tubes inside as well as outside faster with a new Rotojet. The new Rotojet is the most powerful tube cleaner we ever built. It won't stall at low speeds caused by heavy loads. Roto expanding heads and brushes thoroughly clean soot scale inside tubes. A Roto vibrating head (illustrated above) knocks off water scale adhering on the outside.

Try the new Rotojet, and no other tube cleaner will ever satisfy you.

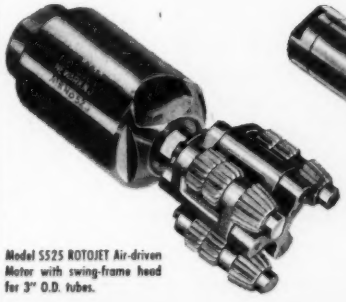
Economical Roto Brushes

Roto expanding brushes and heads have separately replaceable wearing elements. These inexpensive parts save time, money, and critical materials. Send for details.



Roto expanding brush, showing a replaceable brush element. Brings down tube cleaning cost. Maintains high cleaning efficiency.

Roto solid wire brush.



Model S525 ROTOJET Air-driven Motor with swing-frame head for 3" O.D. tubes.

Model S505 ROTOJET Air-driven Motor with 2-arm head for 2" O.D. tubes.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue, Newark 1, N. J.

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Leather
Linoleum
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Leaders in every Industry choose VU

Typical Leaders in the Textile Field that have purchased C-E Vertical-Unit Boilers for one or more mills

American Thread Company
American Viscose Company
American Woolen Company, Inc.
Bancroft & Sons Company
Bigelow-Sanford Carpet Company
Burlington Mills Corp.
Cannon Mills Company
Celanese Corporation of America
Cone Mill Corp.
Congoleum-Nairn, Inc.
Dan River Mills
Goodall-Sanford, Inc.
Mohawk Carpet Mills, Inc.
Standard-Coosa-Thatcher Company
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COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

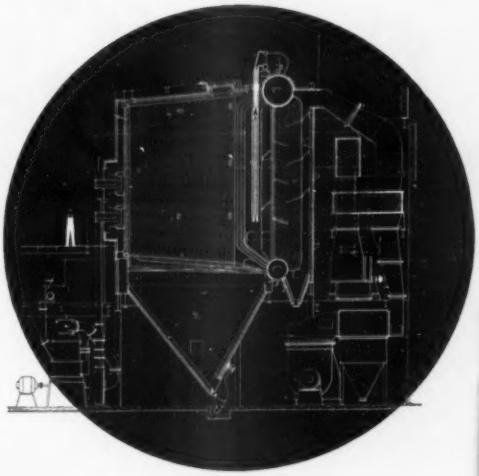
More and more . . . in industry after industry . . . you will find C-E Vertical-Unit Boilers (Type VU) establishing the standards for efficient steam production.

In ***Textile Mills,*** for example . . . where steam must be reliably available for process work . . . many of the industry's leaders, as evidenced by the representative list opposite, are users of Type VU Boilers.

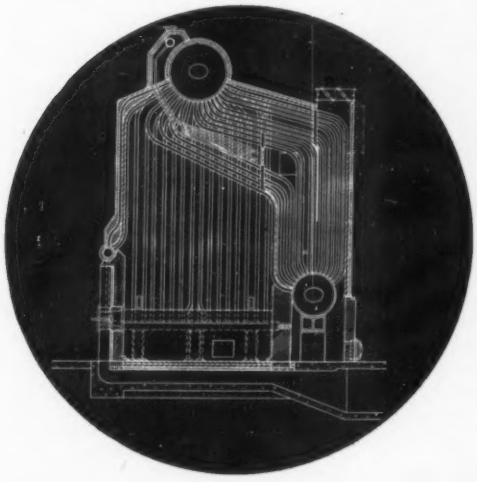
Why list only large companies when VU Boilers are also used by many smaller textile mills? Because such names form a significant guide for a prospective boiler buyer, in the same sense that the buying decisions made by operators of large truck fleets can be a reliable guide for the man who wants to buy a single truck. Moreover big companies buy boilers frequently . . . therefore their experience is always up to date. And they buy them for plants in many locations, using many different fuels. Thus they have the breadth of experience that is required for making the soundest equipment selections.

So if you need steam – from 10,000 to 300,000 pounds per hour – remember that leading companies in every industry are profiting from the advanced design . . . sound construction . . . reliability . . . of C-E Vertical-Unit Boilers.

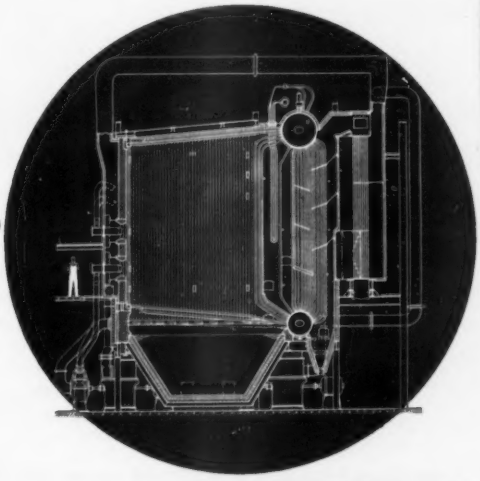
VU-50 Boiler fired with pulverized coal supplied by C-E Raymond Bowl Mills. Capacity—150,000 lb of steam per hr; steam pressure, 600 psi—temperature, 700 F.



VU-10 Boiler fired with oil or gas. Capacity of this unit is 40,000 lb of steam per hr at 420 psi and 600 F. VU-10 capacities range from 10,000 to 60,000 lb of steam per hr. They may also be fired by spreader, underfeed or traveling grate stokers.



VU-50 Boiler fired either with pulverized coal using C-E Raymond Bowl Mills, or oil as an alternate fuel. Capacity is 100,000 lb of steam per hr. Steam pressure is 200 psi; steam temperature is 500 F.



B-572

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

Make boiler water level checking Doubly Sure with Reliance Safety Team

Reliance Alarm Water Column No. W450-C12 and EYE-HYE E901 form the Safety Team at the Philadelphia brewery of C. Schmidt & Sons, Inc.

THE safest way to prevent boiler water level accidents and costly shut-downs is the combination of *visual* and *sound* indications. You're doubly safe when operators can check EYE-HYE's convenient, clear-cut reading right at their control station *augmented* by the alarm on your Reliance Safety Water Column. You don't want that alarm to sound, but it's there, ready to prevent an oversight if gage-reading is delayed. Make *doubly sure* with the Reliance Safety Team. There's a Reliance Representative near you—glad to check your requirements—or write to the factory.

THE RELIANCE GAUGE COLUMN CO., 5902 Carnegie Ave., Cleveland 3, Ohio

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

FLASHING MIXTURES

(Continued from page 61)

mixture assumption is such that pipe and valve sizes obtained by the use of these formulas will always be adequate. In fact, because of the failure of the fluid to attain thermodynamic equilibrium, capacities may be greater than predicted by these formulas. But it is significant that designing on this basis does not result in exorbitantly large sizes, and in many instances results in smaller sizes than would be selected by various empirical formulas that have been used. However, for pipe sizes smaller than $1\frac{1}{2}$ in. and valve line sizes smaller than $\frac{3}{4}$ in., it is unlikely that the fluid behaves as a uniform mixture and as much as 50 per cent more capacity than predicted by formula actually may be obtained.[1]

Test and Calculated Data

Comparison of test data and results calculated by formula (1) for pipe exit critical pressure is presented in Table II. Comparison of test data and results calculated by formula (3) for valve capacity is presented in Table IV. Note that the measured valve flow is slightly more than 10 per cent in excess of the calculated flow, indicating that use of the formula (3) in design will result in maximum valve capacities about 10 per cent greater than the given flow. An appropriate correction to required valve throat area may be made if desired.

Design Procedure

For the purpose of formulating a design procedure, any piping system to convey a flashing mixture or potential flashing mixture of water and steam can be considered in three sections:

1. From the source of fluid to the control valve
2. Control valve (5)
3. From the control valve to the receiver.

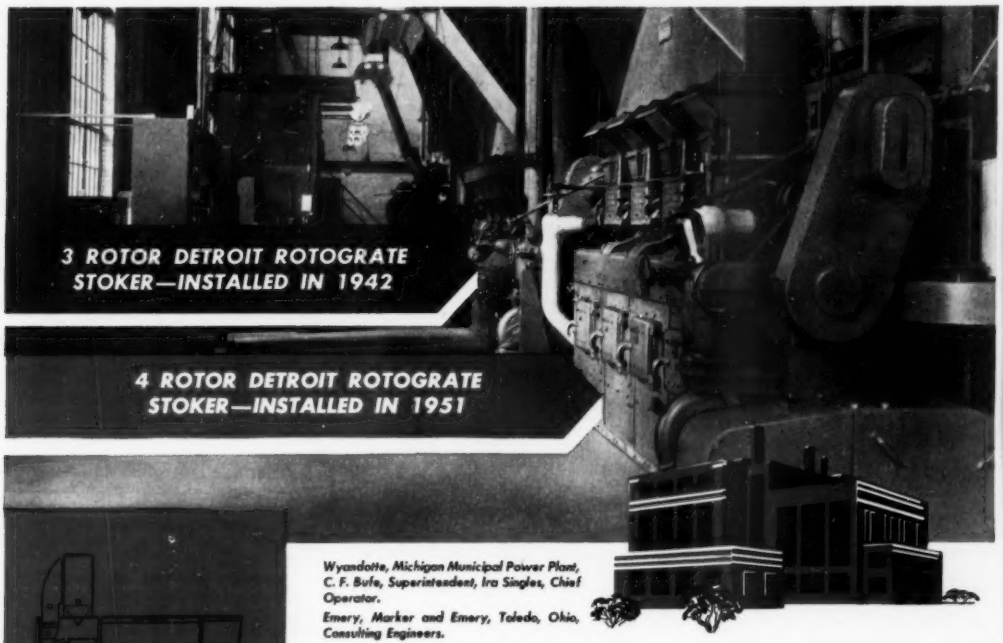
Flashing may occur in one section of the piping system, in two sections, in all three sections, or may be completely eliminated. All cases may be grouped under four headings. The usual fixed conditions in each case are the weight of flow, pressure and temperature of fluid at the source, and the pressure in the receiving vessel.

System Susceptible to Flashing

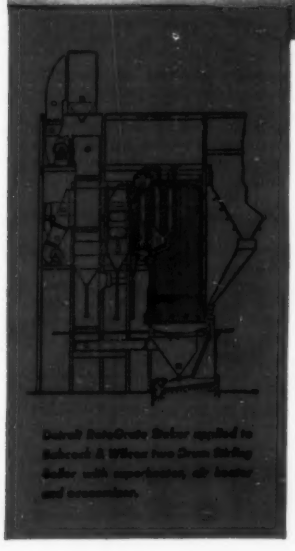
Case A — System susceptible to flashing in which flashing may be completely eliminated: — In one type of system encountered, the receiver pressure is below the saturation pressure corresponding to initial temperature, but the fluid is initially subcooled or compressed, so that the actual initial pressure is greater than the saturation pressure corresponding to initial temperature; as, for example, drains from an extraction feedwater heater provided with an

Detroit RotoGrate Stoker's ability to burn wartime coal Brought Repeat Order—

Municipal Plant, Wyandotte, Michigan



Wyandotte, Michigan Municipal Power Plant, C. F. Bufe, Superintendent, Ira Singles, Chief Operator.
Emery, Marker and Emery, Toledo, Ohio, Consulting Engineers.



In 1942, the Municipal Plant, Wyandotte, Michigan had coal trouble, as did most plants with old type firing equipment. It became almost impossible to operate on the coal they could get.

They purchased a Detroit RotoGrate, which solved their fuel problem immediately. The RotoGrate proved able to burn efficiently any coal available including the poor stuff which war conditions often forced them to use. In the fall of 1951 when they expanded the plant the Detroit RotoGrate was again the stoker chosen.

Detroit RotoGrate is a modern type spreader stoker with grates that move slowly forward, discharging ash at the front. A RotoGrate installation makes it possible to buy the most economical coal, and burn it with highest economy.

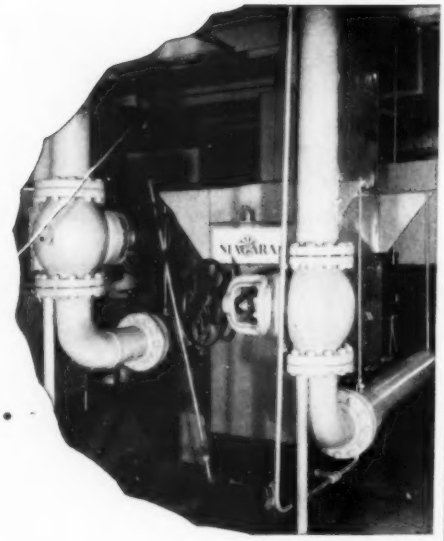
Write for Bulletin.

DETROIT STOKER COMPANY

General Motors Bldg. • Detroit 2, Michigan

WORKS AT MONROE, MICH. • District Offices in Principal Cities

How to get drier or cooler gases . . .



NIAGARA AERO AFTER COOLER cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.

If you use compressed air to operate tools or pneumatic equipment you save much in water and oil damage to tools and equipment, and in water damage to materials by using the Niagara Aero After Cooler.

Write for a bulletin, or ask nearest Niagara Field Engineer if you have a problem involving the industrial use of air.

NIAGARA BLOWER COMPANY

Over 35 Years' Service in Industrial Air Engineering

Dept. E, 405 Lexington Ave. New York 17, N. Y.

Experienced Field Engineers in Principal Cities of U. S. and Canada

integral or separate subcooling zone. Under certain favorable conditions, flashing can be eliminated completely by utilizing the critical pressure phenomena. The section of piping from control valve to receiver is sized so small that the pipe exit critical pressure is equal to or above the saturation pressure corresponding to the exit temperature from the drain cooler.

In order to carry out this design and completely eliminate flashing, there must be sufficient pressure differential available (actual initial pressure plus static head, if any, minus pipe exit critical pressure) to overcome friction in the piping and the differential across the control valve.

Formula (1) is used for the calculation. Since the saturation pressure corresponding to drain cooler exit temperature is substituted for the critical pressure, p_c and p_1 in the equation is the initial saturation pressure, the formula becomes $A = WC$.

Computing Constant C

In computing the constant C, the subscript 1 refers to saturation conditions at the drain cooler exit temperature and the subscript 2 refers to saturation conditions, an infinitely small amount below this temperature. Practically, a finite interval of temperature must be used, so it is most convenient to take the properties corresponding to one degree less temperature than at drain cooler exit, although if a larger interval is used the constant will vary but little. The formula is solved for area. Use of a pipe size with the computed area or any smaller area will ensure that flashing will not occur at the flow used in the computation. After the pipe is sized, the pressure drop due to friction and valve size can be determined by the usual criteria for liquid flow. The minimum flow that it is desired to accommodate must be considered if flashing is to be eliminated at all flows.

Elimination of flashing may be accomplished also with initially saturated liquid water. But the receiver must be located many feet below the source and the static head must be sufficient to overcome friction in the piping and the differential across the control valve.

Flashing will occur as the saturated liquid discharges from the pipe exit into the receiver and it is desirable to provide a suitable impingement baffle in the receiver if it contains tubing. This applies also to all cases under B, C and D (to be explained in a following article) in which the receiver encloses tube surface.

Use of 4-in. Schedule 40 pipe or smaller will result in liquid flow throughout piping system. Available pressure drop for control valve and pipe friction is 17.5 psi.

If given conditions of temperature and pressure and the physical arrangement of equipment do not permit complete elimination of flashing the applicable design procedure is

No "Cover" Charge Here!

THE INDUCED-DRAFT FAN MOTORS look pretty small right out in the open air at the base of the towering stacks. But with today's building costs there would have been nothing small about the "cover" charge for brick and mortar walls and a steel-braced roof to house the motors.

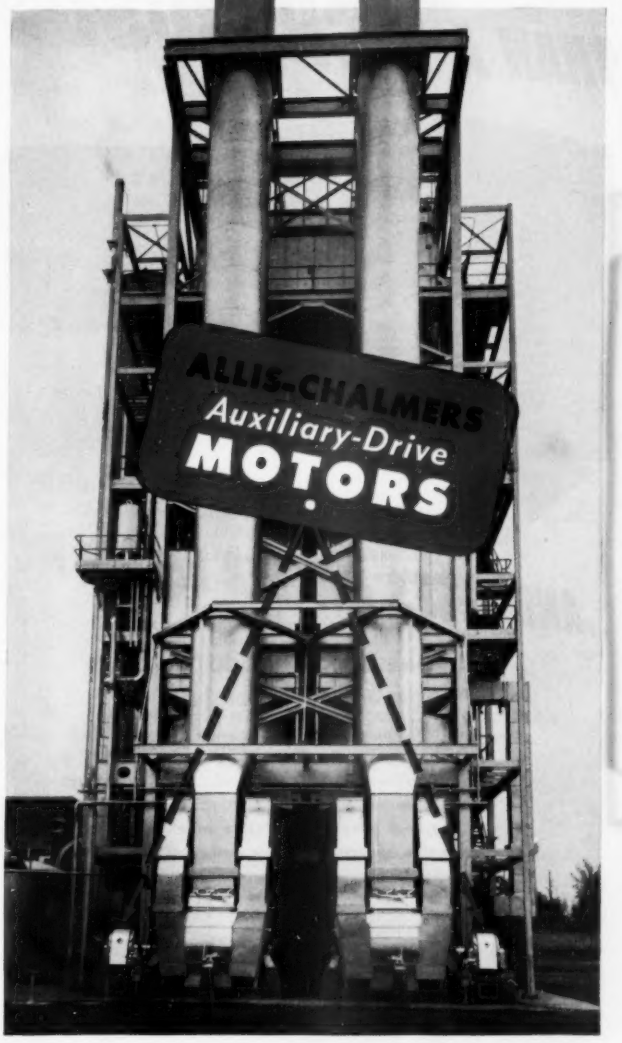
Fortunately, modern Allis-Chalmers auxiliary-drive motors need no costly enclosures.

You can count on Allis-Chalmers motors for the kind of operation you need for continuous power generation . . . because A-C has the experience essential to designing and building motors for outdoor use.

For many years, A-C has been supplying splash-proof motors for a variety of outdoor applications. Since 1946, *tube-type* totally-enclosed fan-cooled motors have been available for operation under the most severe conditions indoors or out. And Allis-Chalmers is now offering *weather-protected* motors especially developed for modern outdoor power plants.

Talk Over Your Needs

All three types are available in sizes and speeds to meet all major auxiliary-drive requirements. Your nearby A-C representative can help you select the motors that will best fit your needs for money-saving outdoor installations. Allis-Chalmers, Milwaukee 1, Wis.



Two 450-hp, 695-rpm, splash-proof cage motors driving induced-draft fans — as well as other Allis-Chalmers auxiliary-drive motors — are installed outdoors at the Natchez Steam Electric Station of the Mississippi Power and Light Company.

A-3653

ALLIS-CHALMERS

YOU CAN'T BUY A BETTER COAL SCALE THAN A RICHARDSON

..AND HERE'S ANOTHER REASON WHY..

INLET OPENING, 20" x 20"

This 400-square-inch opening, *exclusive with Richardson,* ensures positive coal flow and never a "hang-up"—even with wet coal. An even greater area at the conveyor belt, due to the angle of repose of the coal providing pressure relief, is a double guarantee of free flow. It is designed to guarantee the ultimate in dependable, on-the-job operation.

Write for bulletins, and remember . . .

YOU SPECIFY QUALITY WHEN YOU SPECIFY

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

RICHARDSON SCALE COMPANY
Clifton, New Jersey

Atlanta • Boston
Buffalo • Chicago • Cincinnati
Detroit • Houston • Minneapolis
New York • Omaha • Philadelphia
Pittsburgh • San Francisco • Wichita
Montreal • Toronto

8353

covered by one of cases B, C or D, to be explained in another article. These cover situations in which: B-flashing will not occur until fluid has passed through throat of control valve; C-saturated liquid water enters throat of control valve; D-water-steam mixture enters inlet of control valve.

References

1 — Derivation of formulas and other background material appeared in the paper Flow of a Flashing Mixture of Water and Steam Through Pipes and Valves by W. F. Allen, Jr., *Trans. ASME*, Vol. 73, 1951, pp. 257–265.

2 — The Flow of a Flashing Mixture of Water and Steam Through Pipes, by M. W. Benjamin and J. G. Miller, *Trans. ASME*, Vol. 64, 1942, pp. 657–669.

3 — Corrosion-Erosion of Boiler Feed Pumps and Regulating Valves at Marysville, Second Test Program by J. M. Decker, H. A. Wagner and J. C. Marsh; *Trans. ASME*, Vol. 72, 1950, pp. 19–26.

4 — The same characteristic is not displayed for flow through a sharp-edged orifice, as a vena contracta forms which varies in size with the pressure differential across the orifice.

5 — The control device may be wide open (boiler blowoff valve) and offer little or no resistance to flow. An adequate table for predicting capacity of unthrottled lines is given in Tube Turns' catalog.

ENGINEERS' PREVIEW

(Continued from page 8)

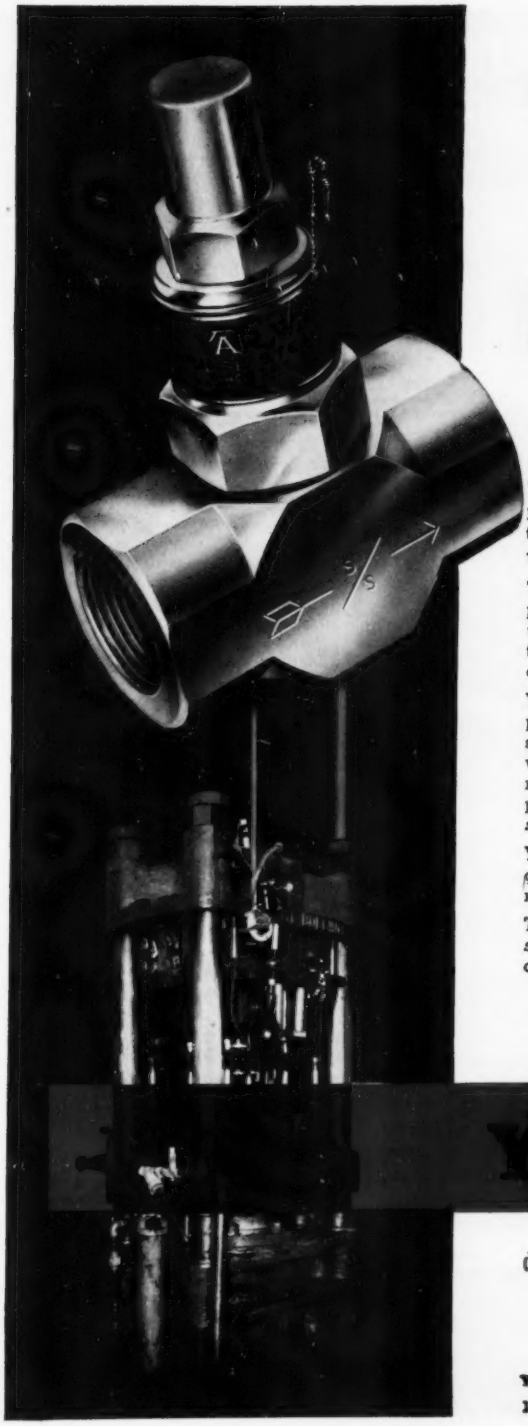
DESCRIPTIONS of 23 patents owned by the United States Government and held by the Atomic Energy Commission have been transmitted to the U. S. Patent Office for registry and listing in the offical register of patents. The Commission will grant non-exclusive, royalty-free licenses on the listed patents, as part of its program to make non-secret technological information available for use by industry. Those interested should apply to the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D. C. Copies of the patents may be obtained from the U. S. Patent Office.

★ ★ ★

NEW FORMULA in parkway development to provide eventually a 2000-mile economical highway along the Mississippi River, right down the spine of the United States, was proposed by J. Lester White at the recent meeting of ASCE. Considerable stretches of existing highway would be used and there would, of course, be the usual problems in getting the ten states concerned to get together on the project. However, a recent survey authorized by Congress reported that, if initiated on a realistic basis and designed to grow with the country, the parkway would be not only practicable but highly desirable.

★ ★ ★

SPRING MEETING of the Prime Movers Committee of the Pennsylvania Electric Association will be held at the Tidewater Inn, Easton, Maryland, on Wednesday and Thursday, May 28 and 29, 1952.



PLASTIC goes to press FASTER

"The use of Yarway Impulse Steam Traps on our platen presses has speeded up our production rates to such an extent that it almost appears we have developed an entirely new process."

That's the Chief Engineer of a large Michigan plastics fabricating plant speaking . . . and he backs up his words by standardizing on Yarways throughout the plant three months after making a trial installation.

You may be surprised at how much faster your product can be produced when Yarways trap your steam equipment. Yarway Impulse traps are designed with production in mind. They insure sending maximum B.T.U.'s at top temperature into your process or product. They get equipment hotter, *sooner* . . . and keep it hot!

Yarway Impulse traps are small, easily installed, good for all pressures, made of stainless steel, require minimum maintenance, cost little.

Try Yarway Impulse traps yourself. Stocked and *sold* by 216 Industrial Distributors. For steam trap advice, call your nearby Yarway trap engineer.

YARWAY

the steam trap designed with more production in mind

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.

ELLIOTT TWIN STRAINERS
give double-barreled protection

SIZES AND BASKET MESH TO SUIT THE NEED

Fourteen sizes—1″ to 24″. Basket perforations, 1/32″ to ⅜″. If finer mesh is desired, basket can be lined with wire cloth. You get the straining service you need with Twin Strainers.

There is practically never any need to shut down a Twin Strainer. It provides its own standby service, thrown into operation by the two-way valves which shut off the fouled chamber.

For over a generation, Twin Strainers have been standard equipment in many industries. Now redesigned with many maintenance-saving features. Get the facts —write for the Twin Strainer Bulletin.

A-317

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Plants at JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

WANT TO build a bridge? You should have done it 25 years ago. Like food, clothes and the baby's shoes, bridges came much cheaper then. Today you might be better off to swim across the river. Here are some of the comparative items of cost recently presented to the ASCE annual meeting by Louis C. Duclos, Head Bridge Designer, Louisiana State Highway Department.

	1927	1951
Open excavation, per cubic yard	$ 2.00	$ 3.70
Concrete above caisson, per cubic yard	17.00	50.00
Concrete in caisson, per cubic yard	10.00	60.00
Reinforcing steel, per pound	0.05	0.17
Structural steel, per pound	0.15	0.50

★ ★ ★

REMEMBER the lignum-vitae bearings on the old water wheels and hydraulic turbines? Well, lignum-vitae has staged a comeback for a number of important purposes in recent years. It is a material that is substituting for critical metals and plastics in mechanical and diversified industrial applications. How it is being used is told in a recent bulletin, which you can obtain from the Lignum-Vitae Products Corp., 96–100 Boyd Avenue, Jersey City, N. J.

★ ★ ★

DR. SOREN H. MORTENSEN, chief electrical engineer for the power department of Allis-Chalmers Manufacturing Co., was installed recently as an Eminent Member of Eta Kappa Nu Association in New York City. Eminent Membership in this electrical engineers' honor society is offered only to those individuals who, by their technical attainments and contributions to society, have shown themselves to be outstanding leaders in the field of electrical engineering and great benefactors to their fellow men. Also installed as Eminent Members with Dr. Mortensen were Dr. Karl B. McEachron of General Electric Co. and Professor William H. Timbie of Massachusetts Institute of Technology.

★ ★ ★

NOVEL MEANS of reversing small electric motors in 3 or 4 milliseconds has been developed by the National Bureau of Standards. Instead of dissipating the kinetic energy of the rotor as heat during deceleration, it is converted into potential energy in a torsion bar spring, and then is used to accelerate the motor quickly in the opposite direction. With proper adaptation, the technique might be used for reversing of other machines.

(*Continued on page 158*)

Sludge . . . a water formed sedimentary deposit which may include all suspended solids in the water. Sludge usually does not retain its physical strength when removed, but it may bake in place and become hard and adherent . . . (Ref. ASTM D 887, D 933).

Use DREW POWER CHEMICALS

Tube failure, expense and inconvenience . . . even plant shut down . . . frequently results from baked-on sludge. Sludge often resembles scale and frequently causes the same troubles. It's the function of every good boiler water treatment to prevent the adherence of sludge as well as scale.

So we say, "Draw a Bead on Boiler Sludge, Mr. Engineer." Call in the Drew engineer. The water samples and operating data that he obtains in your plant will be thoroughly analyzed in the Drew Laboratories, and you'll be given specific recommendations for corrective Drew treatment. Furthermore, your Drew engineer will give you frequent and continuous help in your plant.

Thorough investigation, proper treatment, and frequent service have made Drew one of America's fastest growing water treatment companies. Consult the nearest Drew engineer or write for information.

Power Chemicals Division

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DRAFT FANS GO on GREEN

- Two Induced Draft Fans, each 198,000 cfm; 300°F stack gas at 15" static pressure.
- And special features include: radial tip blades, erosion-resistant wheels, control type inlet dampers, air-cooled bearing for outdoor service.

This installation, located in the South, adds to the mounting evidence that Green Draft Fans are very much in the boiler plant picture, both utility and industrial... evidence that they are high on the specification lists of leading consulting engineering firms and on the owners' lists of acceptable equipment.

There are numerous things about Green Induced and Forced Draft Fans that make them desirable auxiliary equipment for any boiler. We suggest that you have the basic facts at hand when you start planning for your fans. Send for our Bulletin 168 and in writing, tell us about your requirements.

Photo above shows the Green ID Fans being installed in the Chesterfield Power Station Extension of the Virginia Electric and Power Co., at Drewrys Bluff, Virginia.

THE GREEN Fuel Economizer COMPANY INC.

- Economizers
- Fans
- Air Heaters
- Cinder traps
- Aerodyne Dust Collectors

BEACON 3, NEW YORK

New ENGINEERING BOOKS

Mechanical Engineering Laboratory, by Charles W. Messersmith and Cecil F. Warner; 160 pages; illustrated; size 8½ by 11 in.; loose-leaf plastic binding; cardboard cover; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.; price $3.50.

This book has been developed from a set of notes prepared for the students in mechanical engineering at Purdue University, where the authors are respectively Professor of Experimental Mechanical Engineering and Associate Professor of Mechanical Engineering.

Material usually covered in thermodynamics and heat power textbooks has been omitted from this book where possible.

The very first chapter of the book emphasizes a most important point:—the procedure and the method of working up the data from an experiment and presenting the results clearly and accurately in a report.

The following chapters discuss: pressure measurements; temperature, power and flow measurements; heating value of fuels; analysis of flue gas; stationary steam generating units; steam driven prime movers; heat transfer; internal combustion engines and vapor compression refrigeration plants.

An appendix contains the ASME Power Test Codes; a list of words frequently misspelled in laboratory reports; tables of measurement of areas; instructions for curve plotting on logarithmic coordinates; and selected physical properties.

Although intended almost entirely for college use, the book should be of interest to many practicing engineers for it not only illustrates the fundamental principles to be demonstrated by the various experiments, but also includes data on many of the devices and instruments used not only in the laboratory but in actual power plants, such as the Orsat and other types of gas analyzers, various types of electrical meters. It also brings out quite clearly the reasons why these laboratory tests are being made.

The Fontana Project, Technical Report No. 12, by the Tennessee Valley Authority; 706 pages; illustrated; size 6 by 9 in.; cloth binding; published by the U. S. Government Printing Office and obtainable from the Tennessee Valley Authority, Treasurer's Office, Knoxville, Tenn.; price $2.50.

This is another in the series of technical reports covering in complete detail the planning, design, construction and initial operation of the various projects in the Tennessee Valley development. This one covers the Fontana Project on the Little Tennessee River. Discussion is given of the relation of the project to the overall system operations. Aside from its points of public interest, its layout, design and construction involve problems and methods of particular interest to engineers and constructors engaged in the building of large dams. The report contains 706 pages, including 251 illustrations and exhibits.

The report covers in detail: preliminary investigations for the project, including geology and river flow; dam and powerhouse design; construction methods; including construction plant, river diversion, employee housing, and access facilities; relocations and adjustments in the reservoir area; initial operations; and a com-

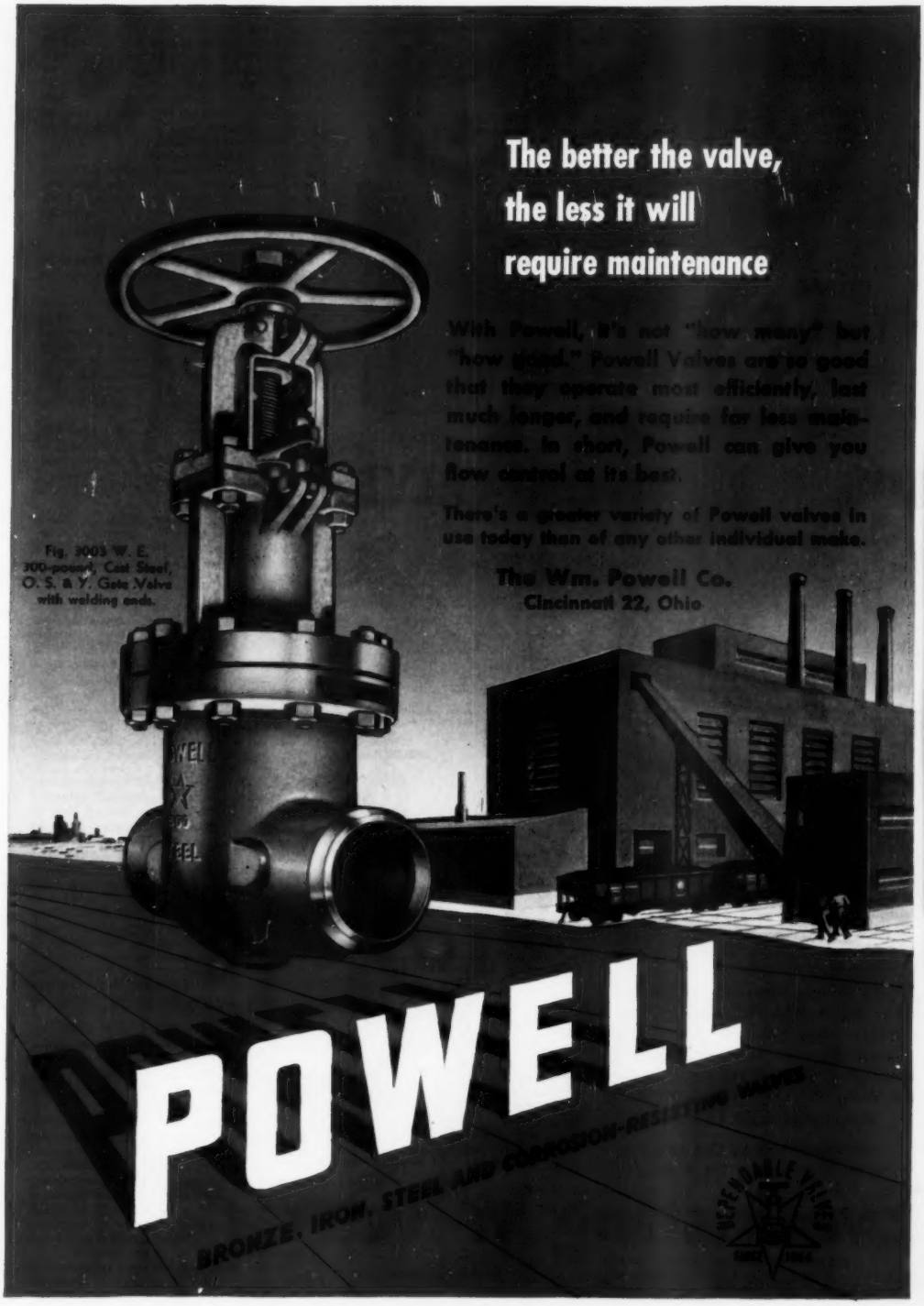
The better the valve, the less it will require maintenance
With Powell, it's not "how many" but "how good." Powell Valves are so good that they operate most efficiently, last much longer, and require far less maintenance. In short, Powell can give you flow control at its best.
There's a greater variety of Powell valves in use today than of any other individual make.
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Fig. 3003 W. E. 300-pound, Cast Steel, O. S. & Y. Gate Valve with welding ends.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES

These EVERLASTING advantages give better service from

Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Angle Blowing Valve.

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When you install an EVERLASTING Duplex Blow-Off Unit, you'll find that its many superiorities speak for themselves.

The sealing valve at the left is the EVERLASTING design that has been famous for more than 40 years . . . the valve with the drop-tight seal that actually improves with use because of its self-lapping action each time the valve is opened or closed . . . the valve that can't stick or jam because of its non-wedge design . . . the valve that opens in less than a quarter turn to provide unimpeded straight-through blow.

The blowing valve at the right is the equally famous EVERLASTING Angle or "Y" Valve, specially designed and equipped to withstand repeated blow-off shocks, erosion and corrosion, and without pockets that might trap and hold solids.

Each of these valves . . . and all the other EVERLASTING Boiler Blow-Off Valve types, fully meet ASME code requirements . . . assurance that they are properly designed and amply strong for the service.

Write for descriptive bulletin

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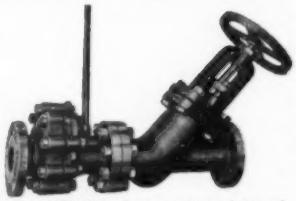

Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Y Blowing Valve.

Fig. 6571/6561. Duplex unit consisting of Y Sealing Valve and Angle Blowing Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Sealing Valve and Y Blowing Valve.

Everlasting Valves

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FOR EVERLASTING PROTECTION

plete summary of the project costs. The appendices include a complete statistical summary of physical features of the project; reports of the engineering and geologic consultants; summaries of hydraulic studies, stress-temperature design, and structural behavior of the dam; and lists of major purchases of material and equipment. Bibliographies on each phase of the project are also included.

Other published reports on the various projects of the Tennessee Valley Authority have been issued from time to time and these, when in print, are currently available from the Tennessee Valley Authority, Treasurer's Office, Knoxville, Tenn.

Tentative Recommended Practices issued by Instrument Society of America.

Flowmeter Installations, Seal and Condensate Chambers, ISA RP3. 1; 8 pages; illustrated; 8½ by 11 in.; published by Instrument Society of America, 921 Ridge Ave., Pittsburgh 12, Pa.; price 50 cents.

This recommended practice has been prepared as a part of the service of the ISA toward the goal of uniformity in the field of instrumentation.

Following adoption of the recommendations contained in this publication, all similar types of seal and condensate chambers would be interchangeable with respect to installation dimensions, regardless of their source of supply.

Three methods of fabrication are shown on the drawings, each illustrative of acceptable manufacturing practices. Two alternate types of condensate or seal chamber are illustrated, each of which may be fitted with any of the three end arrangements. The form of seal and condensate chamber advocated by this recommended practice is consistent with those available either from manufacturers or by field fabrication, and is currently used in a majority of installations.

Uniform Face to Face Dimensions for Flanged Control Valve Bodies, ISA RP 4.1; 4 pages; size 8½ by 11 in.; published by Instrument Society of America, 921 Ridge Ave., Pittsburgh 12, Pa.; price 25 cents.

Dimensions covered are the face-to-face body dimensions for flanged end valves of both cast iron and steel through 600 lb flange ratings. Sizes included are ½ through 8 in. Only flanged valves which are in the category of diaphragm actuated control valves of the plug type are included.

The adoption of the dimensions treated in this recommended practice by all control valve manufacturers will allow piping design, where control valves are involved, without giving special consideration to the make of equipment to be used.

This accomplishment is a result of the joint effort of the National Steam Specialty Club and of the Instrument Society of America.

High-Frequency Transmission Lines, by Willis Jackson; First Edition; 152 pages; 4⅜ by 6½ in.; published by John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y.; 1951; price $1.75.

This is a small, interesting book about the theory of transmission of electrical energy at extremely high frequencies, such as are used in radio transmission work. The wave length of these high frequency currents is of the order of the distance of separation between the wires of the circuit and in such cases the theory of transmission line design, which holds for low frequency currents, no longer is valid.

As the author of this book points out in the preface, the foundations of transmission line theory were laid many years ago

HAGAN Compensated Ring Balance Meters

provide *accurate, automatic* compensation

- for *temperature*
- for *pressure* or
- for *pressure and temperature*

When you measure flow of liquids or gases, and pressure and temperature variations occur, there are two ways to correct meter readings — one by expensive and laborious clerical calculations, the other, by using the Hagan Compensated Ring Balance Meter in the first place. This Hagan Compensated Meter corrects *automatically* for variations in pressure, temperature, or pressure and temperature, and makes a chart record of both the corrected and the uncorrected flow. The built-in integrator totalizes the corrected flow automatically.

Dependable Hagan Ring Balance Meters are simple, ruggedly built, and designed for years of trouble-free service. Some features of Hagan Ring Balance Meters include:

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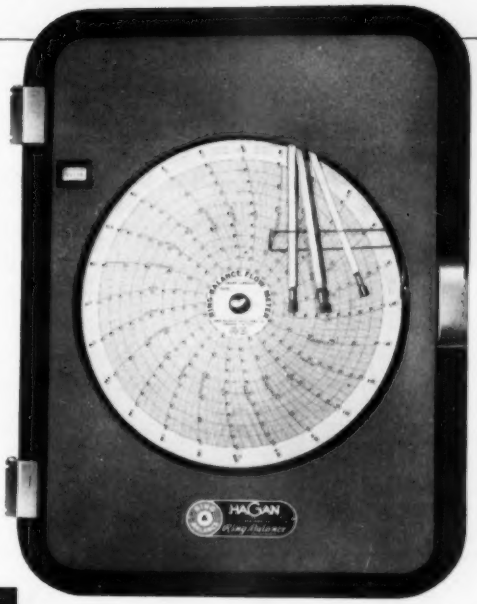

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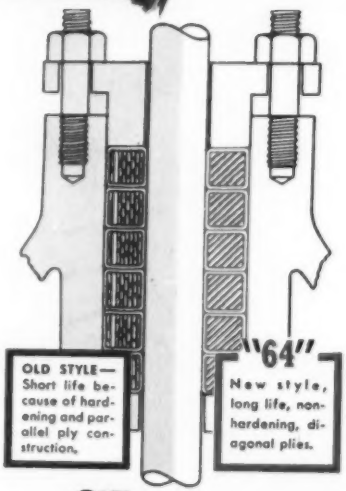
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AMERICA'S OLDEST MANUFACTURER OF MECHANICAL PACKING

by Oliver Heaviside and by J. R. Carson, in various publications in the *Bell Telephone Journal* and elsewhere. No attempt is made in this small book to give a comprehensive restatement of the work of these pioneers, but sufficient is said to bring out the restrictions associated with the application of the theory to high-frequency line systems. The remaining chapters are devoted to consideration of the characteristic properties of lines and of their application in high-frequency technique.

Power System Stability, Volume II, Power Circuit Breakers and Protective Relays, by Edward Wilson Kimbark; First Edition; 288 pages; size 6 by 9 in.; illustrated; cloth; John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y.; 1951; price $8.00.

This is the second volume of a three-volume work entitled Power System Stability. It is intended for use by power system engineers and by graduate students. It grew out of lectures given by the author at Northwestern University in graduate evening courses on power system stability, and power system protection.

This volume covers power circuit breakers and protective relays, including material on rapid reclosure of circuit breakers and on the performance of protective relays during swings and out-of-step conditions. As the author points out, such material belongs in a work on stability because the most important means of improving the transient stability of power systems are: 1) faster clearing of faults by means of faster circuit breakers and relays; and 2) rapid reclosure of circuit breakers. Publication of this material in a separate book will make it more useful to persons who are interested in power system protection, even though they may not be particularly concerned with the subject of stability.

Performance of relays during swings and out-of-step conditions is comprehensively treated both by algebraic and graphical methods. Such material has not been available in book form before.

Now Professor of Electrical Engineering in the Northwestern University Technological Institute, Dr. Kimbark has also taught at MIT and the Polytechnic Institute of Brooklyn. His practical experience with problems of stability was obtained while working with Jackson and Moreland of Boston, and with the General Electric Co. at Schenectady.

Practical Industrial Electronics, by F. A. Annett; First Edition; 381 pages; 6¼ by 9½ in.; cloth; published by McGraw-Hill Book Co., Inc., 330 W. 42nd Street, New York, N. Y.; 1952; price $5.50.

This is a book on industrial electronics which was written expressly for the many operating engineers and electricians now confronted with jobs in the installation, operation and maintenance of electronic equipment, and having little previous training in this subject. It gives them the plainest sort of description of the field covering the electron itself, the various tubes, fundamental circuits and the more complex circuits and performance of many different control devices.

It describes such devices as electronic heating system controls, automatic systems of electronic combustion control, magnetic drive speed control, motor generator exciters, liquid level and pump controls. It clearly discusses the application, circuits and operation of rectifiers, relays, oscillators, smoke indicators and recorders, combustion safeguards and motor speed controllers.

The fundamental electrical circuits are treated in separate chapters.

The simple explanatory treatment throughout the book makes the subject of electronics a simple, useful thing rather than a mystery.

From the Life of a Researcher, by William Weber Coblentz; First Edition; 238 pages; 6 by 9 in.; cloth; published by the Philosophical Library, Inc., 15 E. 40th Street, New York, N. Y.; 1951; price $4.75.

The author of this autobiographical narrative has spent most of his adult life in research problems in thermal radiation, and in studying instruments for measuring such radiation. In this work he has touched upon problems in astronomy, botany, chemistry, physics, psychology, physiology and the human mind, as a selective receiver of cerebric radiation. The earlier chapters describe his personal development and the folk-lore of his time. In one chapter he summarizes the applications of the results of some of his published investigations; in another he gives a short summary of the heretofore unpublished results of his investigations of psychic phenomena which were unconsciously begun in his boyhood.

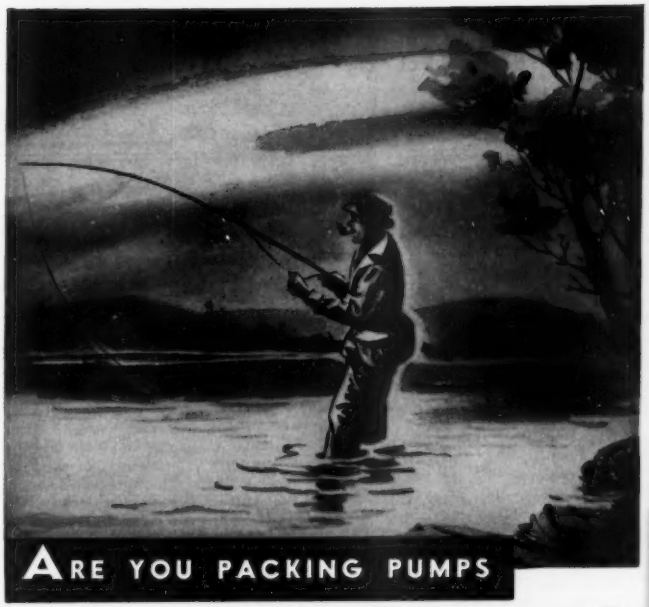
Electrical Measurements, by Forest K. Harris. First Edition; 784 pages; $6\frac{1}{2}$ by $9\frac{1}{4}$ in.; illustrated; cloth; John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y.; 1952. Price $8.00.

Forest K. Harris is physicist at the National Bureau of Standards and Professorial Lecturer in Electrical Engineering at the George Washington University. He has been engaged in electrical measurements work at the Bureau since 1923 and is, therefore, eminently qualified to write on electrical measurements, and this comprehensive work combines the points of view of the practicing engineer and laboratory worker, on the one hand, and the research worker and student on the other.

The book covers all necessary material from basic principles to applications within the field of d-c and low-frequency applications — a coverage which is more thorough than that available in any other book on the subject. As the author points out in the preface, the volume of material on measurements is so great that the scope of the book's content must be limited to only a portion of the field, and so he has chosen to restrict the discussion primarily to direct current and low frequency measurements. Also, Dr. Harris points out, a certain degree of sophistication on the part of the reader must be assumed; therefore it is supposed that the reader is a student of electrical engineering or physics, who already has some acquaintance with the theory of electricity and of electric circuits, or is a laboratory worker who has had equivalent training. Also, it is supposed that the reader has a background of mathematics through the calculus and that he has sufficient laboratory experience to know something about the manipulation of electrical instruments and apparatus.

Dr. Harris discusses the origins, relations and dimensions of electrical units; he then systematically presents basic instrument theory, starting with the study of the galvanometer. This study includes material which has never appeared in print before. Each subject is examined in such a way as to give the reader a good working knowledge of the methods and apparatus used in measurements.

In short, this book offers a thorough, well-balanced authoritative treatment, which clearly shows how best to obtain the required degree of accuracy or repeatability in the job at hand.



when you could be catching trout?

If you are spending your week-ends repacking pumps, you should repack with CHESTERTON "Parachute" Packing. Each ring is self-sealing and permits individual lubrication. The bottom ring has straight sides and can't roll in the stuffing box. CHESTERTON "Parachute" lasts longer, requires no attention, needs no gland pressure and adjusts itself automatically to retain full compression seal. No special adapters are required. This fully automatic packing can cut your packing costs in half at the same time it cuts your repacking time. Specify 600W for water, 600S for steam. 600HO for hot oil and 600CO for cold oil. Ask your distributor or send for full description of CHESTERTON "Parachute". *For longer, carefree week-ends, away from the job, Specify "Parachute".*

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BIDDLE *Instrument News*

NUMBER 6 OF A SERIES

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Megger® Portable Low Resistance Ohmmeters

Self contained battery-operated and rectifier-operated types of Megger Low Resistance Ohmmeters have just been developed. They are designed for hard routine and emergency service in measuring contact resistance, such as in circuit breakers, relays, switches, bonds, connections and joints, commutator bar-to-bar tests and the like.

These portable instruments (weight 19 lbs.), are designed for low resistance measurements in the shop and in the field. They are of moderate cost and are accurate to within 1.5% of full scale deflection.

Model 1B operates from two 4 FH dry cells mounted inside the case.

Model 1R operates from a rectifier, built inside the instrument case, for connecting to 115 volts, 50-60 cycles.

Both models have a range of from .001 to .010 ohms. These new instruments operate on the same crossed-coil ohmmeter principle as the Ducter Low-Resistance Ohmmeter, with pointer indications of resistance and no necessity for balancing or voltage adjustment. Scales have fairly uniform graduations and are approximately 3¼" long. Anyone can operate this equipment—no special training or experience is required.

For particulars and prices write for Bulletin 24-46-P.E.

CABLE FAULT LOCATOR SCORES HIGH IN SAVINGS OF TIME AND MONEY

The BIDDLE IMPULSE CABLE FAULT LOCATOR combines a high-voltage capacitor discharge transmitter with a new type of detector to form a complete Tracer Current Set. This equipment has the advantages of high current and voltage output with small power input and is of moderate size, weight and cost. Also the use of this equipment is not restricted by networks or branches, and under certain conditions will even operate successfully without disconnecting transformers. Furthermore, the method of detection—which is the heart of the set—gives a positive indication of whether the fault has been reached or passed when an exploring pickup coil is applied at various points along the cable.

Equipment now in use has proved highly effective in utility and industrial service. It has made real savings for owners in both time and money. Upon written request on your company letterhead we shall gladly furnish names of users. The coupon below will bring you more details in Bulletin 65-P.E.

FREE REPRINT ON "CABLE-FAULT LOCATING PRACTICES IN PHILADELPHIA"

That is the title of an article which appeared in a recent issue of Electric Light and Power Magazine. It was written by R. S. Diggs, Assistant Superintendent, Service Maintenance Section, Philadelphia Division, Electric Transmission and Distribution Department of the Philadelphia Electric Company.

Mr. Diggs discusses the three methods of locating cable faults used on his company's underground power systems, the a-c method, the thyratron, and the impulse method.

We have obtained a limited supply of these reprints and will be glad to supply them to interested individuals so long as the supply lasts. Ask for Bulletin 65-P.E. on the enclosed card.

JAMES G. BIDDLE CO., 1316 ARCH ST.
PHILADELPHIA 7, PA.
ELECTRICAL TESTING • SPEED MEASURING INSTRUMENTS • LABORATORY & SCIENTIFIC EQUIPMENT

HELPFUL BULLETINS

(*Continued from page 38*)

stone, plaster and asbestos board. Tells ways to apply the paint and outlines its uses. The Corrosite Corp.

144 Thermosetting Phenolic Resin — Bulletin 600 introduces Phenoline 300, an improved corrosion resistant resin which sets hard at room temperature and requires no baking. Gives physical properties, uses, surface preparation and application procedures. Includes test reports, prices. Carboline Co.

145 Corrosion Resistance Chart — Technical Bulletin 501 shows in chart form the chemical resistances of various types of Prufcoat. Based on both laboratory tests and practical applications provides resistance ratings of these coatings to some 69 corrosive chemicals in both concentrated and dilute form. Prufcoat Laboratories, Inc.

METALS

146 Lead Clad Metals — A 22-pp booklet, "The History and Development of Ferrolum Lead Clad Steel and Cupralum Lead Clad Copper," presents a solution to corrosion problems as they exist during the manufacture, transportation, storage and processing of sulfuric acid, as well as information on two mediums well suited to the handling and processing radioactive materials. Interesting, readable text covers properties of these metals, comparisons with sheet lead and lead pipe. Separate chapters are devoted to Cupralum lead clad copper coils, electro-Cupralum anodes. Knapp Mills, Inc.

147 Clad Steel for Coal Handling — The benefits of good design and clad steel construction in coal handling equipment are discussed in Form 584. Nine factors of good design are described. How corrosion and erosion act to destroy coal handling equipment and how clad steel equipment resists such attack are explained. Photos and sketches illustrate text. Lukens Steel Co.

148 Lined Against Corrosion — This bulletin explains how company's economical Leetro-Clad process provides corrosion-resistant linings (nickel or other metals) in pipe, tubing, fittings. Shows how the electro-plated coating becomes an integral part of the pipe. Pictures some available fittings, gives sizes of pipe and tubing supplied. Includes data sheets covering welding procedure, specifications. Bart Mfg. Corp.

149 Long-Wearing Machinery Parts — A variety of cast and wrought alloy parts now used in many industries to solve abrasion, corrosion, and high-temperature problems is described in this 24-pp booklet. More than 60 blueprints, tables and photos show some of the sizes and shapes in which these parts are being used. Parts described are made of Haynes cobalt-, iron- and nickel-base alloys, widely used as metal-cutting tools, chemical equipment, valves, furnace parts. For those troubled with a particular machinery part which has failed repeatedly, there are information forms included. Haynes Stellite Co. Div., Union Carbide and Carbon Corp.

WELDING

150 Welding of Steel Castings — "Recommended Practice for the Welding of Steel Castings" is a 40-pp booklet published by the Steel Founders' Society of America," and described as one of the most authoritative expositions on the subject. Illustrated text covers electrodes, methods, and recommended welding procedures for more than 20 types of steel. Reference bibliography included. Book is available without charge to qualified power engineers; please state title when requesting it. Tempil Corp.

151 Arc-Welding Accessories — Besides showing available equipment, these three bulletins give specifications, type

and catalog numbers. Bulletin GEC-867 describes recommended protective clothing; Bulletin GEC-865 covers helmets and glass; and Bulletin GEC-866 presents brushes, carriers, chipping hammers, paint and weld-spatter compounds and weld gases. All three bulletins available; state those wanted. General Electric Co.

OTHER EQUIPMENT

152 **Faster Steam, Lower Cost** — Form C-10.1 is a 12-pp illustrated booklet describing an automatic self-contained steam generator. Gives details on specific industrial applications of the equipment in reducing costs while automatically supplying a dependable volume of steam at constant levels of temperature and pressure. The use of single and multiple installations is covered and operational data is given. Data on available models and sizes included. Clayton Mfg. Co.

154 **Fluid Power Circuits** — The "Circuit Rider" is a 32-pp pocket-size manual presenting a discussion of basic designs in fluid power circuits together with drawings. Covers air, hydraulic and combination circuits, includes illustrations of JIC symbols. In preparing this manual, company has endeavored to provide a down-to-earth explanation of representative types of fluid power circuits and to show the many possibilities afforded through the use of different types of circuit designs. Logansport Machine Co., Inc.

155 **Mechanical Drive Turbines** — Six new bulletins describe this manufacturer's line of high-efficiency impulse type steam, gas or air turbines for mechanical drive. One of the bulletins is devoted to each of the five types of turbines available, ranging from ¼ to 120 hp, giving performance charts, construction details, dimensions, weights and selection data. The sixth bulletin provides general turbine information. The Pyle-National Co.

156 **Data on Crushers** — Sixteen-pp Bulletin 12-C covering manufacturer's line of crushers includes Knittel ring-type crushers, both single and double rotor; single-roll crushers; double-roll and two-stage double-roll crushers — units designed for reducing coal, coke, other lump materials. Gives capacity and power requirements for crushers reducing run-of-mine bituminous coal to various finished product sizes. Installation dimensions are tabulated. Photos and line drawings show installations, explain operation. Stephens-Adamson Mfg. Co.

157 **Oil Burners** — Eight-pp Form AD-102, describing company's line of Hev-E-Oil burners, contains data on the various sizes and capacities of the burners, available in maximum capacities from 5 to 60 gal. Stresses burners' ability to utilize heavier grades of fuel oil, up to No. 5, as well as present day light oils. Explains how they handle any fuel oil not requiring heating during storage and pumping to burner. Describes and pictures the two basic models of Hev-E-Oil burners, gives specifications of all models. Cleaver-Brooks Co.

158 **Precision Blending System** — This 12-pp folder describes the construction, operation, flexibility and wide application of a system for accurately blending, compounding or mixing of two or more liquids in increments as low as 1/20 per cent. Stresses long-run economy of the system. Illustrated in color, sketches show simplicity and compactness of equipment, photos show various types of installations. Bowser, Inc.

159 **Diesel Cost Comparator** — This handy slide-rule type calculator will help the power user determine yearly savings that can be realized through the use of company's diesels for many applications. The comparator is based on fuel savings experienced by operators. The price differential and the decreased fuel consumption of these diesels are used for determining savings. Cummins Engine Co., Inc.

Specify BOILER FEED PUMPS by Pacific

for small and medium sized boiler plants

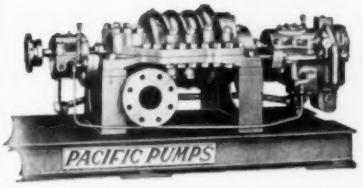
to insure

Reliability . . . Durability . . .
Resistance to Corrosion-Erosion

Dependable Performance and the Highest Factor of Availability at All Times

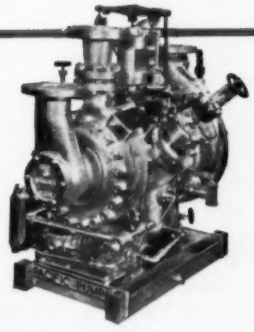
THE Pacific
MULTI STAGE TYPE JBF

Capacities To — 1000 GPM
Discharge Pressures To — 1000 psi
Electric Motor Drive To 3600 RPM
Steam Turbine Drive To 5000 RPM
Speeds To — 10,000 RPM



THE Pacific
SINGLE STAGE-UNITIZED
STEAM TURBOPUMP

Capacities To — 500 GPM
Discharge Pressures to 1100 psi
STEAM To 900 psi Pressure — 850° F. TT
Exhaust Pressures To — 50 psi
Speeds To — 10,000 RPM



PACIFIC Precision Built PUMPS

Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES
HUNTINGTON PARK, CALIFORNIA
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BF-15

Drop Forged SteelS

W-S Screw-End and Socket-Weld Fittings

That's right, W-S emphasizes the *plural* when it comes to the various steels for forged fittings.

From Monel down to the full range of carbon types, including low sulphur and phosphor-controlled grades, W-S *forged* fittings spark the trend toward specialized materials for specialized needs.

What's your problem? STRENGTH? W-S is a leading supplier to the high-pressure, high-temperature power industry. CORROSION? W-S stainless and alloy fittings tie America's main arteries of chemical production. SANITATION? W-S is a big producer of the popular Type 304 for food and pharmaceutical operations. Low temperature? Another W-S specialty.

And there's one problem common to all . . . COST. Let us show you how W-S *forged* fittings provide the lowest *service* cost obtainable.

• Stronger • Smaller • Lighter • Tighter
• More Uniform • Lower *Service* Cost

SOLD THROUGH LEADING DISTRIBUTORS . . . EVERYWHERE

WATSON-STILLMAN
ESTABLISHED 1848

DISTRIBUTOR PRODUCTS DIVISION
ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

Power Engineering

. . . through REGULAR MONTHLY FEATURES helps you with your power engineering problems. . . . TWO POSTAGE-FREE CARDS are provided for you.

1. Streamlines your job reading—

HELPFUL BULLETINS (starts on page 37) reviews for you recently published catalogs and bulletins. List item numbers of those you want on the post cards. You'll receive the literature from manufacturers at no cost to you.

2. Gets you reference literature—

CATALOG LIBRARY (starts on page 121) offers standard manufacturers' catalogs and handbooks. List item numbers of those you want on the post cards. They'll be sent to you free.

3. Keeps you posted on new products—

EQUIPMENT NEWS (starts on page 44) describes new developments in power equipment. Use post cards for listing numbers of products you want to know more about.

4. Provides information on advertised products—

ADVERTISERS' INDEX (starts on page 142) helps you find advertised products quickly. Use the post cards to ask for free literature advertised, product information, names of distributors in your locality.

5. Gives you "extra help" when you need it—

SPECIAL SERVICE is as close to you as the post cards. Use these cards to ask for tear sheets of POWER ENGINEERING articles . . . manufacturers' names and addresses . . . help with a baffling problem . . . to notify us of a change of address . . . or comment on an article.

FIRST CLASS
PERMIT No. 353
Sec. 34.9 P. L. & R.
CHICAGO, ILL.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING
110 South Dearborn
CHICAGO 3, ILLINOIS

FILL IN CARD
TEAR OUT—MAIL

PLEASE PRINT OR TYPEWRITE

May 1952
Card Void in 7 months

POWER ENGINEERING
Please have the manufacturers send me without obligation information or bulletins indicated by the following numbers.

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.....

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Your Name.....

Your Title.....

Your Company Name.....

Company Address.....

City.....State.....

(If you prefer delivery at your home also fill below)

Home Address.....

City.....State.....

Also, use this card for more information on advertised products

HELPFUL BULLETINS

CATALOG LIBRARY

EQUIPMENT NEWS

ADVERTISERS' INDEX

SPECIAL SERVICE

Power Engineering

. . . through REGULAR MONTHLY FEATURES helps you with your power engineering problems. . . . TWO POSTAGE-FREE CARDS are provided for you.

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SPECIAL SERVICE is as close to you as the post cards. Use these cards to ask for tear sheets of POWER ENGINEERING articles . . . manufacturers' names and addresses . . . help with a baffling problem . . . to notify us of a change of address . . . or comment on an article.

MAY 1962
Card Void in 7 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the following numbers.

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Also, use this card for more information on advertised products

PLEASE PRINT OR TYPEWRITE

Your Name. . . . . .

Your Title. . . . . .

Your Company Name. . . . . .

Company Address. . . . . .

City. . . . . State. . . . .

(If you prefer delivery at your home also fill below)

Home Address. . . . . .

City. . . . . State. . . . .

FILL IN CARD
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FIRST CLASS
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BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In the United States

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CHICAGO 3, ILLINOIS

Catalog Library

THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, may appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the postage-free cards on page at left for your request

VALVES, TRAPS, PIPING AND ACCESSORIES

201 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, dimensions; pictures typical installations. The Chapman Valve Mfg. Co. *(See ad on inside back cover for more information on steel valves.)*

202 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Includes dimensions, weights; prices. Everlasting Valve Co. *(See ad on page 112 for more information on blow-off valves.)*

203 Iron Body Gate Valves — Bulletin 805, 8 pp, covers company's popular iron body, bronze trim gate valves in both outside screw and yoke and non-rising stem types, telling best applications for each. Design features are explained and illustrated. Gives dimensions, working pressures, and prices. The Ohio Injector Co. *(See ad on page 6.)*

204 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, tables on superheat correction factor. Manning, Maxwell & Moore, Inc. *(See ad on page 40.)*

205 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes — 150 to 2500 lb — and include globe and angle, gage, instrument, hydraulic and relief types, also strainers, and check, gate, non-return and blow-off valves. Explains design features. Edward Valves, Inc. *(See ad on page 93.)*

206 Gate Valves — Literature is available on cast steel outside-stem-and-yoke gate valves; also on bronze, iron, steel and corrosion-resisting valves in a variety of types. The Wm. Powell Co. *(See ad on page 111.)*

207 Blow-off Valves — Illustrated Bulletin B-433, 24 pp, describes blow-off valves for high-pressure boilers, and covers seatless, hard-seat and unit-tandem types, for working steam pressures from 400 to 2500 lb. Construction details and operating principles are illustrated. Dimensions and specifications included. Yarnall-Waring Co. *(See ad on page 54.)*

208 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co. *(See ad on page 140.)*

209 High Pressure Gate Valve — Described in 4-pp Form DH-273 is a forged steel gate valve designed for long service and low cost maintenance. Working pressures, sizes and prices listed. R-P & C Valve Div., American Chain & Cable Co., Inc.

211 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co. *(See ad on page 122.)*

212 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc. *(See ad on page 41 for information on constant supports.)*

213 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering and application data; includes a section on products for refrigeration service. Fully illustrated, indexed. Available to qualified power engineers; please give your title. Henry Vogt Machine Co. *(See ad on page 32 for information on condenser towers.)*

214 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co. *(See ad on page 45 for information on pressure regulators.)*

216 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, prices. Yarnall-Waring Co. *(See ad on page 107.)*

217 Solving Steam Trap Problems — This popular 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install traps and service them. The V. D. Anderson Co. *(See ad on page 95.)*

218 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air, gasoline, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb. W. H. Nicholson & Co. *(See ad on page 130.)*

219 Forged Fittings — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman. *(See ad on page 118.)*

220 Duplex Strainer — This literature describes company's Duplex strainer with single handwheel control. Shows how it is designed with only one stuffing box and can be cleaned under full flow. R. S. Products Corp. *(See ad on page 124.)*

221 For Double-Barreled Protection — This bulletin describes company's twin strainers built with a two-way valve and designed to provide standby service — one strainer works even though the other is shut off for cleaning. Describes operation of the twin strainer, stresses advantages. Elliott Co. *(See ad on page 108.)*

PUMPS AND COMPRESSORS

223 Controlled Volume Pumping — Illustrated Bulletin 151, 24 pp, on controlled volume pumping will be of interest to engineers whose plant operations call for pumping a controlled volume of liquid in amounts from 3 ml per hour to 50 gpm. Describes features of company's pumps and includes data for selecting pumps for specific applications, 170 chemicals. Milton Roy Co. *(See ad on page 33.)*

224 General Purpose Pumps — Six-pp Bulletin 52B6351B presents a pedestal mounted pump in capacities to 2500 gpm for temperatures to 250 F and designed for direct coupling or V-belt drive. Cutaway illustration shows construction, sketches show pedestal arrangements. Dimensions included. Allis-Chalmers Mfg. Co. *(See ad on page 105 for information on boiler feed pumps.)*

225 Compressor Selection Chart — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Shows recommended compressor bore and stroke in inches. Worthington Corp. *(See ads on pages 22–26.)*

PACKINGS, GASKETS, SEALS

227 Manual on Packings — Containing 84 pp of engineering and ordering information, Catalog 40 covers packings for practically every service. Includes packaging recommendation charts, conversion tables. The Belmont Packing & Rubber Co. *(See ad on page 136.)*

228 Metallic Packing — An elastic metallic packing for compressors, engines and pumps is described as to construction and advantages in this illustrated bulletin. Explains easy installation of the packing, illustrates installations. A. W. Chesterton Co. *(See ads on pages 114 and 115 for information on other packings.)*

229 Seals for Bearings — Complete information on mnaufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co. *(See ad on page 52 for information on expansion joints.)*

230 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc. *(See ad on page 20.)*

231 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. These, in turn, are illustrated with close-up photos and construction information, sizes, etc. Packings and gaskets are grouped on the pages according to recommended applications and services. Where packings have more than one application, cross-references are supplied. Johns-Manville. *(See ad on page 144.)*

DART UNIONS don't get tight, stay tight because of an ordinary "jammed" joint. Their tightness comes from a precision-ground, bronze-to-bronze ball joint that comes apart readily and remakes repeatedly — as tight as when new.

Both seats are non-corrosive bronze for top protection against pitting and corrosion. Nuts and both ends are high test, air refined malleable iron — practically indestructible in use or abuse.

Remember, the *extra* work life of a Dart is money in your pocket! Darts can be installed and reinstalled, time after time, with absolute assurance of tightness.

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston New York Pittsburgh

DART
UNIONS

BOILERS AND AUXILIARIES

233 Shop-Assembled Boiler — Eight-pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock & Wilcox Co. (*See ad on pages 34–35.*)

234 Re-Circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or load fluctuating. Explains operation, features. Combustion Engineering-Superheater, Inc. (*See ad on pages 100–101 for information on vertical unit boilers.*)

235 Steam Generator — Bulletin 1050 describes a fully automatic generator available in 10 to 500 hp capacities and furnished completely equipped ready for installation. Cutaway drawing illustrates design of the unit; major parts are discussed and pictured, full dimensions included. Lists fuel burning equipment provided for use with light and heavy oils, gas, or combinations. Ames Irons Works. (*See ad on page 140.*)

236 Streamlined Baffle Walls — Bulletin BW-44, 20 pp, describes company's baffle walls, showing their application to modern boilers and for modernizing existing units. Fully illustrated with photos and drawings covering installations, remodeling designs. The Engineer Co. (*See ad on page 30 for information on fuel oil units.*)

237 Soot Blower Head — Illustrated Bulletin 485 describes a rotary soot blower head for improved boiler cleaning. Explains how head is designed to give maximum blowing pressure, is rugged, easily serviced, economical. Vulcan Soot Blower Div., Continental Foundry & Machine Co. (*See ad on page 14.*)

TUBING

239 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators and other applications. Discusses heat transfer properties, high temperature use. Also discusses prevention of galvanic corrosion. Bridgeport Brass Co. (*See ad on page 129 for information on Duronze IV tubes.*)

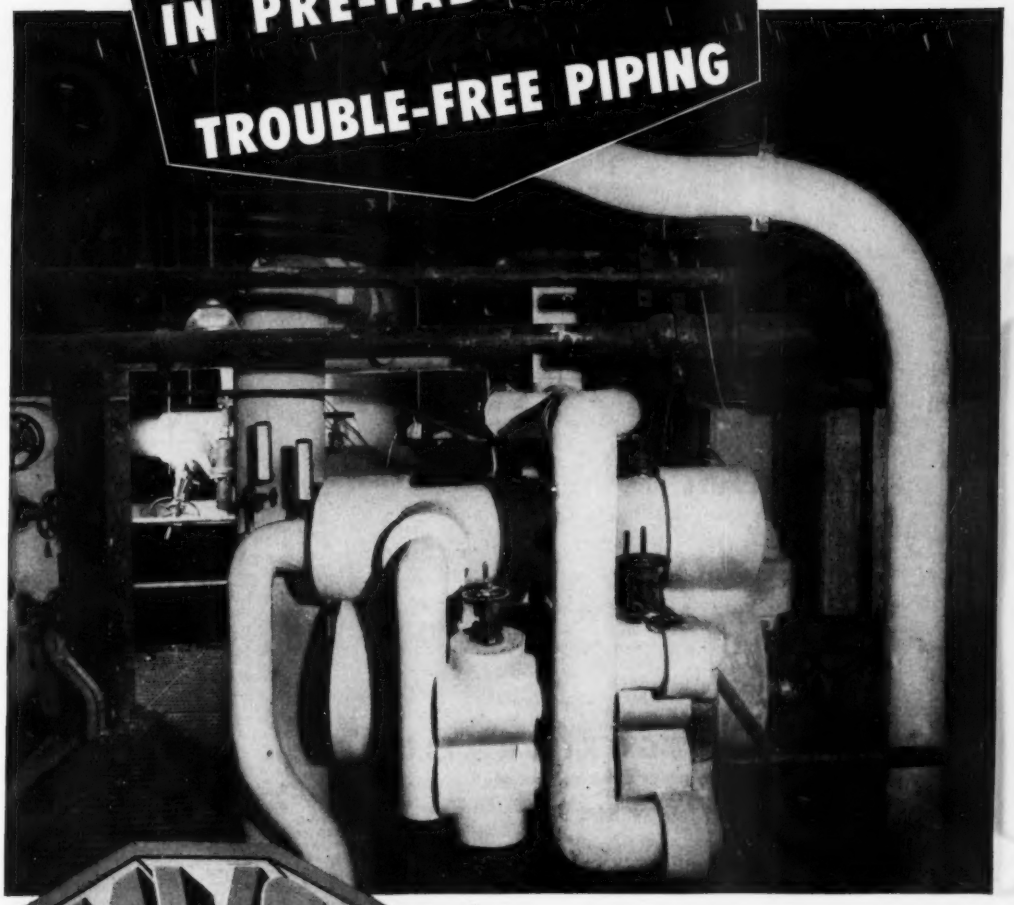
240 Using Alloy Steel Tubing — Assistance in solving problems involving use of alternate grades of low carbon, or carburizing grades of tubing steels is offered in Bulletin TDC 149. Presents condensed data on microstructure, critical points, effect of alloy elements, forging, machining, welding and thermal treatment for 14 well-known alloy steels used in the production of tubular parts. Tubular Products Div., The Babcock & Wilcox Co. (*See ad on page 94 for information on welded boiler tubes.*)

FUEL OILS, LUBRICANTS

242 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel and heating oils, dust control. Examples of increased production and lowered costs resulting from use of this service are cited. Gulf Oil Corp., Gulf Refining Co. (*See ad on page 53 for information on turbine lubricants.*)

243 Lithium Soap Greases — Twelve-pp Booklet AD3084, on manufacturer's Stanolith greases, explains how they withstand both high temperatures and wet operating conditions. Discusses two grades — one recommended for central dispensing systems, and a heavier grade for compression

NAVCO ACCURACY IN PRE-FABRICATION TROUBLE-FREE PIPING



NAVCO

Prefabrication accuracy is an essential "MUST" to assure a proper fit and economical operation. Navco's 40 years' experience in fabricating assemblies in all sizes and for all operating conditions is your assurance of such accuracy.

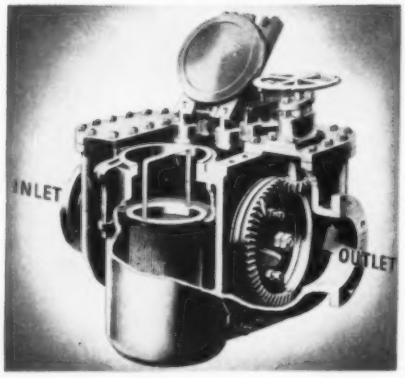
Consult Navco for your next piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

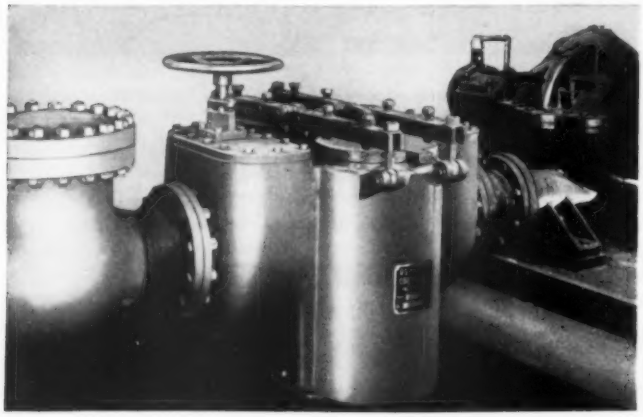
R-S Duplex Strainer



- **SINGLE HANDWHEEL CONTROL!**
  Geared turning plate is in constant contact with the seat, cannot become loose or fouled and is fully controlled by 2½ turns of the single handwheel.
- **CLEANED UNDER FULL FLOW!**
  Either of two large interchangeable basket strainers can be removed for cleaning without flow shut-off.
- **ONLY ONE STUFFING BOX!**
  Designed for minimum pressure drop and low maintenance, the R-S Duplex Strainer is available for nearly all liquids in 4-inch to 24-inch pipe sizes. Has no equal for efficient heavy industrial service.

Call your local R-S Engineer or write direct

R-S PRODUCTS CORPORATION
4600 Germantown Avenue • Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary



cups or pressure gun applications. Difficult lubrication jobs successfully handled by Stanolith greases are described and pictured. Standard Oil Co. (Ind.) *(See ad on page 39 for information on turbine oil.)*

244 Fuel Oil Treatment — By text and sketches, this folder points out undesirable conditions in the storing, pumping, heating and burning of industrial fuel oil and correction of these conditions by company's treatment. E. F. Drew & Co., Inc.

245 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co. *(See ad on page 13 for information on combustion efficiency.)*

246 Lubrication of Diesel Engines — An excellent instruction manual, 50-pp Technical Bulletin B-1 (revised) also provides a brief history on diesel engines, an explanation of the fundamentals of design and the common types of diesels and their advantages. Explains combustion process, discusses modern fuel injection systems. Cylinder and bearing lubrication are treated in detail and recommendations given for lubricating oils. There's also a chapter on diesel fuels. Maintenance and operation are covered and a trouble-shooting chart included. Sun Oil Co. *(See ad on page 9.)*

247 Clean Oil for Diesels — A combination purifying and filtering unit utilizing centrifugal force and controlled filtration is the subject of illustrated Bulletin DL-1. Explains operation of the unit, tells advantages. Discusses importance of clean, dry lubricants. Also discusses purification of fuel oil for diesel engines. The DeLaval Separator Co. *(See ad on page 91.)*

CONDENSERS

249 Condenser Tubes — Excellent factual information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper tube installation are presented, as are specifications, conversion tables, weights of tubes and alloys, formulas, terminology. Scovill Mfg. Co. *(See ad on page 21.)*

250 Steam Condensers with Reserve Flow — Eight-pp Catalog 410-1 describes a "self-cleaning" reverse-flow condenser for power plant service, designed to virtually eliminate cleaning downtime and, in the case of divided water box condensers, eliminate operation at partial load. C. H. Wheeler Mfg. Co. *(See ad on pages 42-43.)*

INSTRUMENTS AND CONTROLS

252 Pressure Regulator — Bulletin 1-B, 8-pp discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for controlling back pressure relief valve and high pressure make-up valve. Atlas Valve Co. *(See ad on page 136.)*

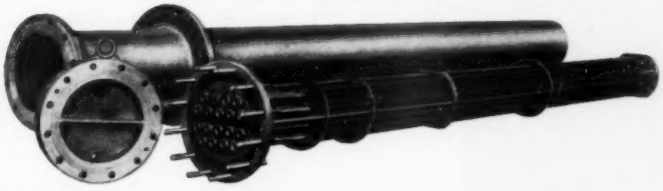
IT'S EASY to ask for these catalogs. List item numbers on the postage-free cards on page 120.

They heat storage tank oil
4 times as fast
with a G-FIN HEATER

At a petroleum refinery near an east coast community, the oil truck drivers complained about the hour-long turn-around time. They pointed to a nearby refinery where the cold viscous oil in storage tanks was being heated much quicker.

The refinery manager checked, found the other refinery was using G-Fin Storage Tank Oil Heaters, and ordered them for his own tanks. Result . . . the oil was made to flow so much faster that truck turn-around time was cut from 1 hour to 15 minutes.

The reasons for this superior performance of G-Fin Storage Tank Oil Heaters are described in a bulletin which every refinery executive in charge of loading racks and blending stations should have. Write for a copy, without obligation of any kind.



THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GR 269

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

Treat Cooling Water *with Chlorine* — the Proven Way

HELP MAINTAIN MAXIMUM PLANT EFFICIENCY..

Hundreds of power plants and refineries have found chlorination by W&T the answer to heat exchanger slime problems. By eliminating slime forming microorganisms, maximum heat transfer is maintained in the condensers. The result — overall plant efficiency is kept at a maximum.

REDUCE LABOR COSTS...

High labor costs involved in frequent condenser tube cleaning are eliminated when chlorination is employed. Man-hours used for tube cleaning can be utilized for other maintenance jobs, an important factor with the increasing manpower shortage.

REDUCE DOWN TIME....

Elimination of frequent shut-down for tube cleaning helps power plants stay continuously "on the line." When chlorination is employed, many plants find that outage for cleaning is reduced to once per year and then only for removing trash from tube sheets.

W & T Air Operated Visible Vacuum Chlorinator

Years of operation have proved the dependability and accuracy of W&T Chlorinators for cooling water treatment. Low maintenance and automatic program operation keep operating costs to a minimum. For information on how you can solve your slime problems, contact your nearest W&T Representative or write to:

CD-35a

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

253 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co. (*See ad on page 116 for information on other testing instruments.*)

254 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains principle of operation. The Reliance Gauge Column Co. (*See ad on page 102.*)

255 Putting the Ratio Totalizer to Work — Twelve applications of company's ratio totalizer in automatic control circuits are shown in 8-pp Bulletin 5450. This is a pneumatically operated control mechanism for combining input control pressures and spring forces to produce a single output control pressure. Hagan Corp. (*See ad on page 113 for information on compensated ring balance meters.*)

256 Catalog 001, 30 pp, is devoted to measuring and control equipment for water and sewage works, power and processing industries. Describes in detail: venturi tubes and meters, controllers, gages, manometers, pilots. Simplex Valve and Meter Co. (*See ad on page 134.*)

257 Temperature Instruments — This catalog gives full details about company's complete line of industrial glass, dial and recording thermometers, electronic temperature indicators and recorders. Fully illustrated, includes application information. American Industrial Instruments, Manning, Maxwell & Moore, Inc. (*See ad on page 127.*)

259 For Centralized Control — Bulletin 109 presents compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes and illustrates vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Co. (*See ad on page 12 for information on other control equipment.*)

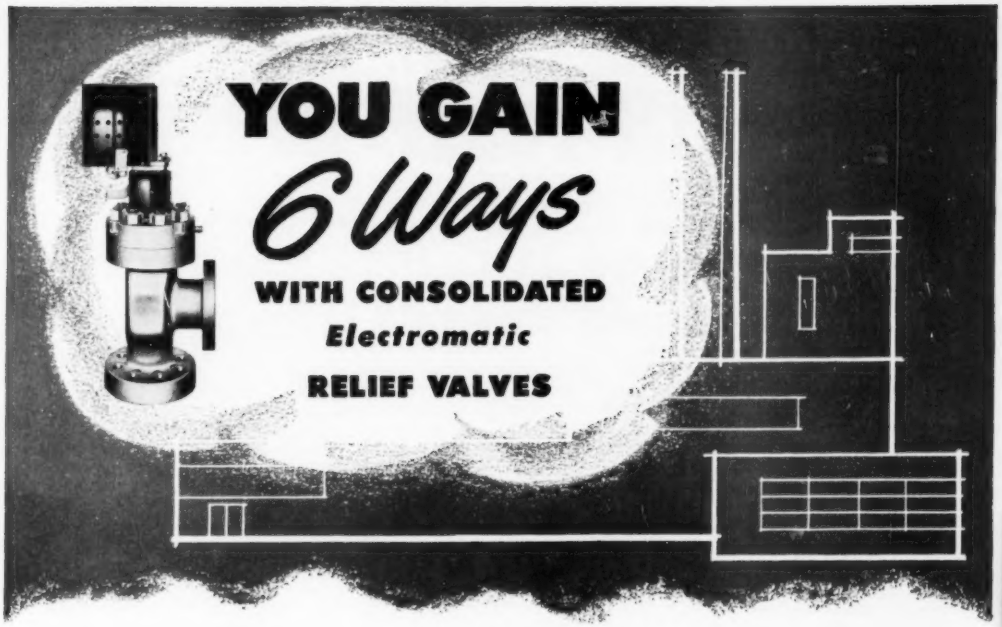
260 Instruments, Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co. (*See ad on pages 96–97.*)

261 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co. (*See ad on page 51.*)

TOOLS

263 Pipe Tool Book — This is the latest edition of company's catalog and data book giving information on pipe and bolt machines, power units, ratchet threaders, reamers and cutters, other power and hand tools. Includes popular "operating guide" section. Fully illustrated with easy-to-grasp drawings, clear technical copy. Beaver Pipe Tools. (*See ad on page 138.*)

264 Screwdriver Handbook — Besides providing full ordering information, 32-pp Catalog SD-551 serves as a reference encyclopedia on screwdrivers, nutdriver kits and other hand tools. Book is profusely illustrated in color and punched for filing in binder. Includes a handy screw and screwdriver reference chart. Vaco Products Co. (*See ad on page 139.*)

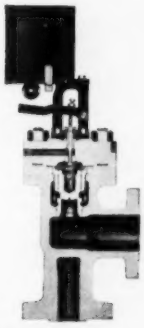


The Consolidated Electromatic is an automatic, electrically actuated, pressure relief valve for boiler service. It can be set for 1% or less differential between opening and closing pressure – relieves pressure precisely within close limits. A switch or a pressure-sensitive element is used to actuate the solenoid which operates the valve.

The valve can be operated automatically, manually or cut out of service entirely by setting the switch. The entire cyclic action is practically instantaneous. High superheat temperatures or other variables do not affect the valve operation.

The Consolidated Electromatic can also serve as a superheater surge vent valve or to purge a superheater or a header – reduces the possibility of damaging the seats of regular valves and turbine equipment. Because it can be operated manually at any pressure, positive circulation is guaranteed through the superheater and greater steam flows are obtained than normally possible by the vent valves, during start-up periods. This minimizes the danger of burning superheater tubes.

With the installation of a Consolidated Electromatic Relief Valve, you are assured of: (1) more accurately balanced boiler operation at peak loads; (2) more uniform line pressure; (3) power conservation; (4) less maintenance of spring-loaded safety valves; (5) greater protection against overheating the superheater because it provides additional flow through the superheater under all conditions of operation; (6) increased efficiency of the steam generating plant.



CONSOLIDATED
Electromatic
RELIEF VALVE
Sizes: 2½", 4", 10", 14"
Pressures: Up to 2500 p.s.i.
Temperatures: Up to 1100°F.
Standard Connections: A.S.A. flanged and welded.

Detailed information about the installation and operational features of Consolidated Electromatic Relief Valves is yours on request.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN
MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

265 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co. *(See ad on page 99.)*

266 Internal Tube Cutter — This bulletin describes a time-saving pneumatic tube cutter for use on heat exchangers and condensers. Tells how it is used for cutting, trimming and serrating jobs. Armstrong & Sons. *(See ad on page 130.)*

267 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators and miscellaneous equipment are also presented. Also provided is a chart of tube cleaner sizes. Thomas C. Wilson, Inc. *(See ad on page 139.)*

COOLING

269 Heat Exchangers — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co. *(See ad on page 104 for information on after-cooler.)*

270 Cooler with Fins — A new oil and water cooler and advantages of its improved design are described in 20-pp Bulletin 1020. Explains how company's LK-Fin Cooler, distinguished by use of helically-finned heat transfer elements instead of bare tubes, is a lighter, more compact and less costly unit. Diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface. The Griscom-Russell Co. *(See ad on page 125.)*

COAL, ASH HANDLING

272 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co. *(See ad on page 106.)*

273 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp. *(See ad on pages 16–17 for information on boiler units.)*

274 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's RotoGrate stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. More than 20 such installations are described, illustrated. Detroit Stoker Co. *(See ad on page 103 for information on stokers for handling wartime coal.)*

275 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly ash control, coal storage pile treatment and boiler cleaning. Proportioning units for liquid diffusion compounds are described and pictured. Johnson-March. *(See ad on page 141.)*

REFRACTORIES, INSULATION

277 Refractory Brick — Electric furnace fused refractory bricks and their use is described in Form 862, 16 pp. Gives installation procedure on a high quality silicon carbide brick for boiler furnaces and gas generators. Also describes a fused aluminum brick of high refractoriness. Fully illustrated. Norton Co. *(See ad on page 28.)*

278 Incombustible Material — "The Story of Kaylo," 24 pp, describes company's new basic material, an hydrous calcium silicate product, covering some of the many uses for this incombustible material in construction and industrial fields. Tells how product was developed, describes its properties, tells densities available for thermal, insulating and structural applications. Kaylo Div., Owens-Illinois Glass Co. *(See ad on page 47.)*

WATER CONDITIONING

280 Water Conditioning Information — Here are three informational bulletins. No. 28X7446 describes a simple way to determine total hardness in water, illustrating procedure. No. 28X7559 gives an analysis of the hot process-hot zeolite system telling results to be expected. No. 28X7466 discusses current status of embrittlement in boilers, explaining causes and telling recent developments in control methods. List bulletins wanted. Allis-Chalmers Mfg. Co. *(See ad on page 15 for information on sludge-scale control.)*

281 Chlorination for Power Plants — Form RA-2061-C is a 20-pp technical article, "Recent Developments in Chlorination and Equipment for Power Plants." Discusses such subjects as industrial water chlorination, the desliming processes, air pilot chlorinator operation, organic slimes and scales, chlorine ammonia reactions, chlorine residual recording. Illustrated with photos of equipment, performance charts, diagrams. Wallace & Tiernan Products, Inc. *(See ad on page 126.)*

282 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for indi-

RODA

High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

DENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK

The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE

Roda and Stonega from Wise County, Va.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL

High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER

Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO

High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

ANTHRACITE

Hazel Brook—*Premium Lehigh*
Raven Run—*Premium Mahanoy*
Cross Creek—*First Grade Lehigh*

Our engineering service, available upon application, and long and varied experience is your assurance of the Right Coal — Properly Applied.

General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

CABLE ADDRESS, GENCO

BRANCHES:

BLUEFIELD, W. VA. BUFFALO CHARLOTTE, N. C. CINCINNATI
NEW YORK NORFOLK PITTSBURGH

BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

PHYSICAL PROPERTIES OF DURONZE IV— Arsenical Aluminum Bronze Tubes

Each alloy possesses special physical and chemical properties which makes it ideal for certain conditions. However, since circulating water is subject to continual changes in composition, temperature, velocity, debris, sediment and biofouling, it is difficult to state in advance which alloy will give the maximum service life. Fortunately, considerable data has accumulated with time which gives us a greater insight on the behavior of alloys and their resistance to corrosion.

Fresh Water Conditions

Duronze IV (95% copper, 5% aluminum, and approximately 0.25% arsenic) shows good to excellent resistance to a wide variety of fresh waters. Field tests conducted in Lake Erie showed corrosion rates of a very low order. It is not susceptible to "coppering", a type of attack sometimes encountered in high-zinc brasses where it is known as dezincification. In fresh water polluted with paper mill wastes, Duronze IV showed superior corrosion resistance over the standard copper-base condenser tube alloys. However, in the presence of debris, localized corrosion may occur.

Brine and Sea Water

Duronze IV shows good to excellent corrosion resistance to brines. It is not recommended for use in brines containing a high concentration of sulfides but stands up well when the sulfide content is low.

Duronze IV gives good to excellent performance in sea water depending upon the nature and extent of contamination by industrial refuse and sewage.

Effect of Arsenic

In tests at Kure Beach, North Carolina, conducted in clean, flowing sea water, Duronze IV (arsenical aluminum bronze) proved twice as corrosion-resistant as aluminum bronze without arsenic.

Extensive air-impingement corrosion tests conducted in salt water contaminated by sewage resulted in deep, rapid, localized corrosion pitting in non-arsenical aluminum bronze. Localized pitting, sometimes called pin-hole attack, is characterized by the formation of narrow pits which rapidly deepen and eventually pierce the tube wall. In contrast with the pits formed by air impingement, the inside surface of these pits is dark and discolored, even scaly. The addition of a small percentage of arsenic to this alloy not only renders it more resistant to air-impingement type of corrosion but improves its resistance to pitting.

Biofouling Retarded

Due to its high corrosion resistance, Duronze IV is susceptible to fouling by marine organisms. The living organisms may obstruct the flow and affect the heat transfer rate. They cause no difficulty as far as corrosion is concerned. However, dead organisms, particularly barnacles, when allowed to remain attached to the surface of the metal, often lead to pitting.

This is explained by the fact that Duronze IV has a low rate of solubility in sea water. It therefore does not introduce to the water film adjacent to its surface enough copper salts to be toxic to marine organisms.

Under conditions where biofouling is severe such as in warm, clean sea water, care should be taken to keep the Duronze IV tubes as clean as possible. The water velocity should be high enough (continuous at 6 feet per second or higher) to prevent marine organisms from attaching themselves to the metal surface. Chlorination should be sufficient to discourage biofouling. Dead marine organisms, particularly barnacles, should be promptly removed by mechanical means.

Paint sprayed on water boxes and tube sheets and inadvertently inside of condenser tubes has led to intense localized pitting. Therefore, paints should be applied cautiously in order to prevent trouble from this source.

Chlorinated Sea Water

Duronze IV is generally more resistant to chlorinated sea water than other copper-base alloys such as Admiralty, aluminum brass and cupro nickel.

In common with other copper-base alloys, Duronze IV shows excellent corrosion resistance to steam and steam condensate. However, steam condensate contaminated with much ammonia may lead to stress-corrosion cracking. Duronze IV is not recommended for service involving the handling of high concentrations of ammonia. Under such conditions Duplex Tubing with steel to the ammonia side and a copper-base alloy to the water or brine side is very satisfactory.

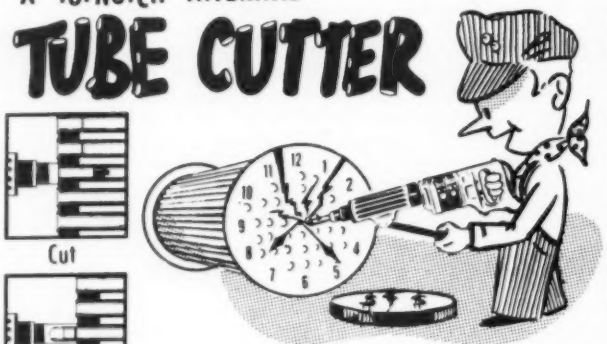
PHYSICAL AND MECHANICAL PROPERTIES—ALUMINUM BRONZE 53

ANALYSIS	
Copper	94.25
Aluminum	5.5
Arsenic	0.25
MECHANICAL PROPERTIES	
Tensile Strength—Soft	50,000
Yield Strength—Soft	20,000
Elongation % in 2" Soft	53
Contraction in Area % Soft	70
Rockwell Hardness—Soft	F78
Elastic Limit—Soft	10,000
Modulus of Elasticity in Tension x 10^6	17.5
PHYSICAL CONSTANTS	
Density @ 68° F lbs./cu. in.	.295
Specific Gravity	8.16
Melting Pt. °F Liquidus	1945
Solidus	1920
THERMAL CONSTANTS	
Coefficients of Thermal Exp. per °F from 68°F to 572°F x 10^{-6}	10.0
per C° from 20°C to 300°C x 10^{-6}	18.0
Thermal Conductivity at 68°F BTU/sq. ft./ft./hr./°F	46
Calories/cm^2/cm/sec/°C	0.19
Thermal Capacity (spec. heat) @ 68°F BTU/lb./°F	.09
@ 20°C cal./gm./°C	.09
ELECTRICAL CONSTANTS	
Resistivity ohms/mil foot @ 68°F (annealed)	60
Conductivity % IACS @ 68°F (annealed)	17
(annealed) megohm-cm^3 @ 20°C	0.099
Resistivity, micro-ohm centimeters @ 20°C (annealed)	10
Color	Pink Silver
FABRICATION PROPERTIES	
Cold working	Good
Hot working	Good
Hot working Temp. °F	1450-1600
Hot working Temp. °C	800-925
Machinability rating	20
Soft soldering	Good
Silver brazing	Good—special flux
Oxyacetylene welding	Good—coated rods
Carbon arc welding	Good—coated rods
Resistance welding	Fair
Polishing	Good
Annealing Temp. °F	1000-1200
SPECIFICATIONS	
A.S.T.M.	B-111-50
A.S.M.E.	SB-111

(8277)

A TOPNOTCH INTERNAL

TUBE CUTTER



SAVES OUTAGE, COST AND TIME

A top notch Internal Tube Cutter, Type AA, is the result of years of research by our engineers in the heat exchanger and condenser repair field. These time-saving cutters, the most efficient tool of their type, are now used by the world's leading power plants, refineries, chemical plants and shipyards.

Available in the following standard sizes: ⅝", ¾" ⅞" and 1".

Write today for complete information with descriptive bulletin.

ARMSTRONG & SONS

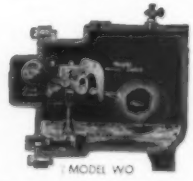
1059 LINDEN AVENUE — RIDGEFIELD, NEW JERSEY

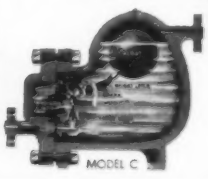
Nicholson W. O. Traps Are

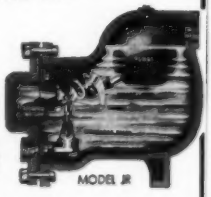
LEAKPROOF IN SUPER HEAT

Nicholson weight-operated traps will not leak live steam, even though body may become completely dry due to re-evaporation. Unlike most bucket and float traps, Nicholson units do not depend on buoyancy of float to raise valve. Their extremely large orifices also keep valve clean, preventing blow-through. Working parts of stainless steel.

3 TYPES, for every heavy-duty use; pressures to 1500 lbs. Also for air and gasoline.


MODEL WO


MODEL C


MODEL JR

Catalog 751 or see Sweet's

160 Oregon St.
Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

TO GET this literature, just list the item numbers on the postage-free cards on page 120.

vidual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes available equipment and includes reference bibliography of literature on specific formulations. Dearborn Chemical Co. *(See ad on page 49 for information on return line corrosion.)*

283 Water Softening Equipment — How problems caused by hard water can be offset by water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. The Permutit Co. *(See ad on back cover.)*

284 Slurry Type Softener — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. Question-and-answer appraisal of system. Worthington Corp. *(See ads on pages 22–26.)*

286 Carryover Prevention — Eight-pp Technical Paper 115 discusses the role of anti-foam agents in the prevention of carryover of boiler water solids with steam. Fully illustrated, covers mechanical and chemical influences on carryover, foaming and anti-foam action, types of anti-foam agents. W. H. & L. D. Betz. *(See ad on page 87.)*

287 What's New on Ion Exchangers — Here are three booklets covering company's ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp. *(See ad on page 36.)*

288 Modern pH and Chlorine Control — This 100-pp booklet gives details of company's color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co. *(See ad on page 144.)*

289 Organics in Water Treatment — Here's a folder describing need for organics in altering nature of sludge to make it non-adherent. Covers theoretical and practical considerations involved in use of organics; tells how they overcome problems of sludge. Power Chemicals Div., E. F. Drew & Co., Inc. *(See ad on page 109.)*

290 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition and application. Wright Chemical Corp. *(See ad on page 132.)*

291 Zeolite Water Softeners — Publication 4530, 16 pp, presents hydrogen zeolite (cation exchange) water softening equipment. Gives complete description of the process and the field of application, showing advantage of hydrogen zeolite softening and

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cooling tower drive shaft and universal joint

Angular deflection and load fluctuation no longer constitute service problems in cooling tower operation. By applying power through pre-loaded, bonded-to-metal inserts of pressure moulded neoprene, TWINFLEX drives fully compensate for starting loads and misalignment. This means protection to costly bearings and gears, and eliminates maintenance. These universal joints require no lubrication . . . in fact are impervious to oil as well as water. TWINFLEX dynamically balanced drive shafts are of electro-galvanized tubular steel and are sealed against internal corrosion. The TWINFLEX Drive shaft and universal joint are the first application of this most modern design power transmission to cooling towers . . . another in the long line of exclusive engineering advancements that makes Marley the world's largest producer of water cooling towers.

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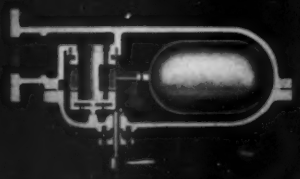
COCHRANE MULTIPORT DRAINER

(Continuous Flow Steam Trap)

CONTINUOUS DRAINAGE of low pressure condensate and HIGH DISCHARGE CAPACITY are features of the Cochrane Multiport Drainer that have made these continuous flow steam traps popular the world over.

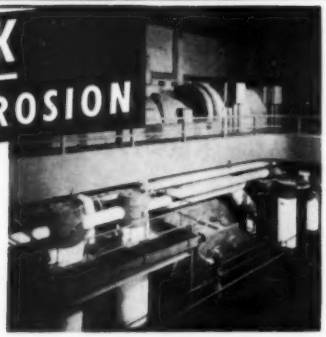
Balanced Rotary Valve and large port areas permit instant response to great discharge demands. Valve opening is determined by height of water in float chamber. As volume of water increases, the larger the valve opening becomes.

Other features: Valve never leaves its seat and is self-cleaning. Inlet at top prevents possibility of trap becoming air bound. Rotary Valve Seat is attached directly to float stem, one moving element. Write for Publication 4340.



COCHRANE CORP., 17th ST. & ALLEGHENY AVE., PHILADELPHIA 32, PA.

DON'T RISK SCALE AND CORROSION



Control them with **WRIGHT**

PREVENTIVE MAINTENANCE SERVICE!

EXCESSIVE scale and corrosion in your power plant equipment can result in costly production delays and unnecessary maintenance costs. Hundreds of plants are now using Wright Water Conditioning Chemicals to control, and in many cases eliminate, scale and corrosion in boilers, steam and condensate lines, water jackets, condensers—in fact wherever water is used.

The Wright Service includes more than the chemicals. It starts with a scientific analysis of your water conditioning problems. The recommended solution to your specific problem will be based upon our specialized knowledge gained in years of practical water conditioning experience. Write us or call in your Wright Field Engineer for a study of your system.

Wright CHEMICALS

WRIGHT CHEMICAL CORPORATION

Specializing in Water Conditioning

GENERAL OFFICE AND LABORATORY

619 West Lake Street, Chicago 6, Illinois

OFFICES IN PRINCIPAL CITIES

Sole Distributor of Nelson Chemical Proportioning Pumps

its relation to sodium zeolite softening process. Cochrane Corp. *(See ad on page 92.)*

OTHER EQUIPMENT

293 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's preheater, discusses its application to boiler plants. The Air Preheater Corp. *(See ad on page 18.)*

294 Transmission Belting — Catalog M-9922, 28 pp, gives design, engineering and performance data on transmission belting. Tables on belt speeds, arc of contact, friction, horsepower correction, and service factors. United States Rubber Co. *(See ad on page 31 for information on friction tape.)*

295 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. Gives construction features, drive arrangements. The Green Fuel Economizer Co., Inc. *(See ad on page 110.)*

296 Refrigerant Gas Purgers — How air and other non-condensables get into refrigeration systems, adverse effect of this on operating costs and efficiency, and how company's forged steel purger works to prevent this are covered in 8-pp Bulletin 192. Includes installation data, specifications and prices. Armstrong Machine Works. *(See ad on page 4 for information on steam traps.)*

297 How Good Is That Furnace? — Form 926 describes and illustrates the Heat Prover, an instrument for measuring the combustion efficiency of any type furnace using any type fuel, giving both instantaneous and continuous readings. Tells how instrument works, explains advantages in checking performance of boilers, open hearth furnaces, kilns, heat treating furnaces, crucibles. Cities Service Oil Co. *(See ad on page 13.)*

329 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Discusses steam and oil control valves. National Airoil Burner Co., Inc. *(See ad on page 14.)*

299 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, with tube bundles removable. Davis Engineering Corp. *(See ad on page 134.)*

300 Turbine Generators — Bulletin H-18, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical turbine condenser installation arrangement. Elliott Co. *(See ad on pages 10–11.)*

USE THOSE postage-free cards on page 120 to request any of these catalogs. Just list the item numbers of the ones you want.

It's your SCRAP for more Steel!

CASE STUDY NO. 1:

88 Carloads

Here's a photographic equipment manufacturer with a systematic metal-salvage program. No more scrap, they said. Yet, after more careful study, they found 88 carloads of heavy iron and steel scrap in a 30-day period!

CASE STUDY NO. 2

Metalworking Plant Surprised!

This big fabricator reported all scrap being turned in. When told needed scrap includes old equipment, not just "production" scrap, they uncovered extra tons of iron and steel.

CASE STUDY NO. 3:

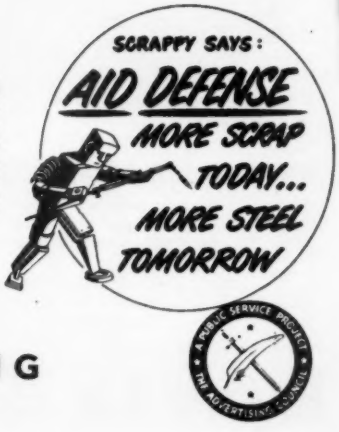
Paper Converter Delivers!

This plant replaced 3000 obsolete machines with new ones. Held old ones for occasional spare parts. Changed mind, scrapped 2800, reduced inventory.

You, too, may have iron and steel scrap you don't know about. Almost *any* plant has.

That scrap is badly needed to aid defense. Steel mills may have to let furnaces grow cold unless they get more scrap to meet the needs of greatly expanded capacity.

Remember—we need 3000 carloads of scrap a day for steel mills and foundries—much more than we are getting now. Every pound counts. Start *your* scrap salvage program *today* by writing for your copy of "Top Management: Your Program For Emergency Scrap Recovery", to Advertising Council, 25 W. 45 St., New York 19, N. Y.



NON-FERROUS SCRAP IS NEEDED, TOO!

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A PUBLIC SERVICE PROJECT THE ADVERTISING COUNCIL

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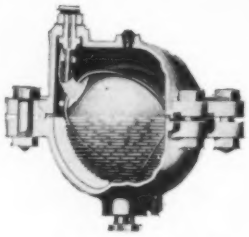

a BIG Trouble Saver that Costs You LITTLE!

When air lodges at high spots in pipe lines, it reduces the effective area of the pipe, creates a friction head, lowers pumping capacity, and may result in serious water hammer!

Simplex Air Release Valves bring you a sure, efficient cure for these difficulties . . . venting air *automatically before it can cause damage.*

The Simplex Air Valve is easily installed . . . positive in action . . . ample in capacity. Standard valves for pressures up to 250 p.s.i. . . . special valves for pressures up to 800 p.s.i. Thousands have been in successful use for over 30 years.

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SIMPLEX
VALVE AND METER COMPANY

Paracoil EVAPORATORS
for STATION HEAT BALANCE or FRESH WATER SUPPLY

Shop View of SALT AND FRESH WATER EVAPORATORS built by PARACOIL for San Juan Steam Electric Station, Porto Rico Water Resources Authority, San Juan, Porto Rico. Jackson & Moreland, Boston, Mass., Consulting Engineers

HERE'S A JOB WE'VE BUILT FOR SAN JUAN, P. R.

Wherever pure water is needed for boiler feed makeup, process work or general plant operation, a PARACOIL EVAPORATOR is a proven, time-tested means of handling any kind of initial raw water—salt or otherwise.

They are ruggedly built—dependable—and easily maintained. Specific requirements dictate the design. Our years of experience in building units of this type—and other power plant apparatus—assures you of the correct solution to your problem. *We invite your inquiry.*

DAVIS ENGINEERING CORPORATION
1062 East Grand Street, Elizabeth 4, New Jersey
30 Rockefeller Plaza, New York 20, New York

"BUILT-IN" ECONOMIES HELP POWER INDUSTRY EXPAND

"BUILT-IN" ECONOMIES are keeping the electric utility industry in business and even enabling it to expand in the face of increased taxes and rising operating costs, the ASME was told at its spring meeting at the University of Washington.

All utility costs have increased markedly, some three or four times as much since 1930, while the general increase since 1940 is 110 percent, Wallace L. Chadwick, vice president in charge of engineering and construction, Southern California Edison Co., and Edwin H. Krieg, consulting engineer, Stone & Webster Engineering Corp., declared in a jointly-prepared paper.

To remain in business without raising electric rates in the same proportion as rising costs has required the utmost ingenuity in engineering, design and construction of generating plants to continually lower fuel consumption while providing higher availability with lower operating and maintenance costs, they said.

"The four most important elements in the cost of energy are taxes, fuel, capital and labor," they said. "In 20 years, taxes of electric utilities in Southern California have jumped from about 1.5 mills per kwh to almost 4.0 mills at present. Fuel oil costs, during this period, have climbed two to three times.

Dump Gas Higher

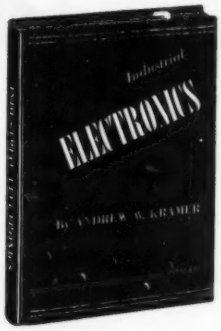
With "big inch" and "super-inch" lines now carrying natural gas to big population centers for heating, the cost of this fuel is rising rapidly. Even the cost of dump gas is increasing. In a few cases, such as those where strip mining and water transportation are possible, coal costs have decreased but most operators find them materially higher.

Construction and material costs have advanced along with the marked increase in the cost of all labor. Construction wage rates, with related pay roll taxes and the new fringe costs, have soared about 4.5 times since 1930. The cost of materials and equipment has climbed along with labor.

Operating labor costs have increased along with construction labor costs. Although the average rate for money is appreciably lower than 20 years ago, so much more is now required for a given job that the benefit of lower money rates is largely lost. Yet, without being able to raise electric rates to offset these costs as they rise, the industry must raise more capital in less time than ever before — currently, more than two billion dollars a year for new facilities.

To raise new capital, a fair return must be assured the investor. How then has it been possible for the industry to continue in business? There is no single answer, but certainly one of the most important is the ingenuity which has been exercised in the

(Continued on page 136)



a practical new book about Electron Tubes

. . . what they are
. . . how they work
. . . how they can be used
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INDUSTRIAL ELECTRONICS

by Andrew W. Kramer

This new book explains in clear, simple, non-technical style the basic principles of electronics, and how these principles can be applied in industry. Electronics has been solving the unsolved problems. Whether it is navy beans, opening doors at a shadow, or measuring the thickness of red-hot steel plates, the electron is the newest and most efficient force captured by science. This book should be invaluable for the practical maintenance or operating executive or engineer. 311 pages, 229 illustrations, $6.00.

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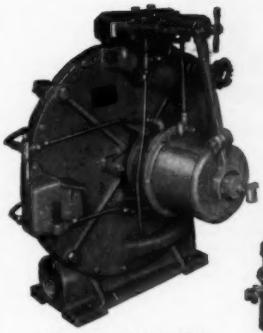

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OPERATING RANGES

	Standard	Maximum Pressure
Horsepowers	100	150
Temperatures	525°	750°
Pressures	275	600
Back Pressures	50	50
Speeds	4000 RPM	4000 RPM

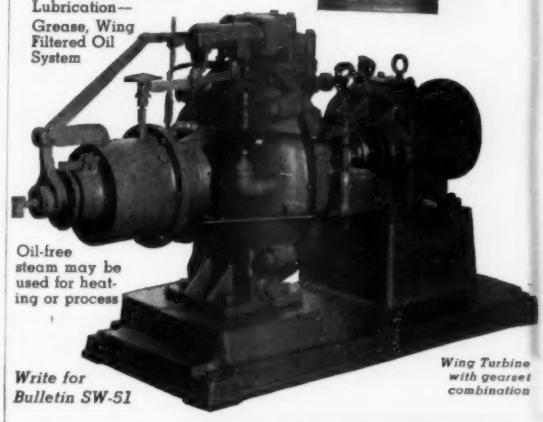
Welded Steel Wing Turbine on Vertical Pump

Capable of exhausting against HIGH BACK PRESSURES

Shafts—Horizontal or vertical

Rotation—Clockwise or counter-clockwise

Lubrication—Grease, Wing Filtered Oil System



Oil-free steam may be used for heating or process

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Wing Turbine with gearset combination

L. J. Wing Mfg. Co. 64 Vreeland Mills Rd.
Linden, New Jersey
Factories: Linden, N. J., Montreal, Canada

Wing **AUXILIARY STEAM TURBINES**

ATLAS

Super-Sensitive

PRESSURE REGULATORS

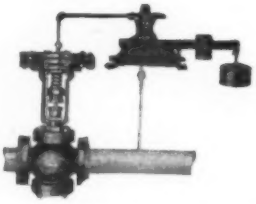
Specify

No. 801—for reduced pressures 2 to 15 lb.
No. 801-B—for reduced pressures 0 to 5 lb.
No. 802—for reduced pressures 15 to 150 lb.
Sizes ½", ¾", 1", 1¼", 1½", 2", 2½", 3", 4", 5", 6".

Steam—Air—Gas

Ideal for Maintaining Controlled Pressures Without Variation — Regardless of Fluctuating Demand or Varying Initial Pressures.

For Regulating Steam — Air — Gas — in Fractions of One lb. to Atmosphere — or Higher — in One Stage.



Where?

For services where it is essential to maintain a constant reduced pressure as in heating mains, vats, cookers, retorts, etc. They may also be applied as altitude regulators to maintain constant level in open tanks, or as a pump governor to assure constant pump discharge pressure.

Ask for Bulletin

Bulletin No. 1-B is devoted entirely to ATLAS Super-Sensitive Pressure Regulators. In addition to the numbers above there is a Compound design, also covered in the bulletin.

The coupon below makes it easy to obtain 1-B and data on the other ATLAS products listed.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

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☐ Without obligation, please send "Bulletin No. 1-B." Also, please send complete information on the following ATLAS products:

☐ Damper Regulators	☐ Reducing Valves
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☐ Exhaust Control Systems	☐ Oil Control Cocks
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	☐ Control Valves

Name.....

Firm.....

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engineering, design and construction of generating plants which continually lower fuel consumption while providing higher availability with lower operating and maintenance costs.

The engineers gave examples of some of the economies being built into the new 250,000 kw Etiwanda Steam Station of the Southern California Edison Co.

Higher Maintenance Costs

Maintenance costs for the past decade in steam power plants have risen faster in proportion to total production expenses than fuel and operating costs, Burton C. Mallory, chief mechanical engineer, and Fred W. Argue, assistant chief power engineer, Stone & Webster, said in another paper presented at the same session. It cost the average steam plant in 1950 about twice what it did ten years before to keep capacity in service even though one-third of the capacity is new, they said.

Using 1941 and 1950 figures, the engineers said the installed capacity increased slightly over 50 per cent while the load factor increased from about 34 to 44 per cent.

The fuel costs per kilowatt-hour rose about 50 per cent, maintenance costs about 50 per cent, and other costs which include operation, only about 25 per cent. However, maintenance expressed as dollars per kilowatt-year of installed capacity increased nearly 100 per cent.

Basing the figures on dollars of comparable value, if the costs per kilowatt-year for both operating and maintenance expense are divided by the building cost index, it is discovered that operating expenses have decreased by 16 per cent between 1941 and 1950 while maintenance expenses have risen by 13 per cent, it was stated.

Holding Costs Down

Maintenance, they said, is a sizable item, being between 11 and 12 per cent of the total production expense per kilowatt-hour, and therefore, justifies careful consideration.

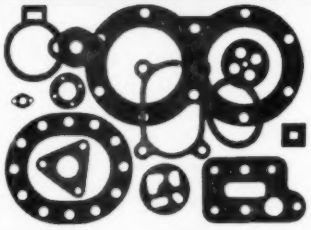
The Stone & Webster engineers said, generally speaking, maintenance may be minimized by:

1. Installing equipment that has demonstrated its reliability.
2. Selecting equipment that may be disassembled, repaired if necessary, and assembled again readily.
3. Providing facilities to permit rapid overhaul.
4. Keeping equipment in good operating condition by periodic overhauls rather than operating until a breakdown occurs requiring major replacements.

They discussed the third requirement in detail: provision in the plant layout for space and facilities which will permit rapid overhaul or replacement and for such "broom closets" as will improve the accessibility of maintenance tools and equipment.

Gaskets by BELMONT

Made Right to Seal Tight . . . LONGER



There's a Belmont Gasket — molded, formed, extruded, or die or lathe cut—for every gasketing service. They're made for *better* joint and surface seals . . . under any combination of service conditions . . . from a wide range of materials including Compressed Asbestos, Woven Asbestos Metallic, Red Rubber, Cloth Inserts, Black Rubber, Vegetable Fibre, Cork-Vegetable, Gray Rubber, Neoprene, Buna-N, Teflon, Silicone and many other compounded materials.

Because Belmont Gaskets are accurately and uniformly cut from just the right material to suit your particular service, they can usually be expected to deliver a valuable saving in maintenance costs and uninterrupted service by providing longer, more dependable service life.

Write or call your Belmont Distributor for recommendations . . . and get reference Catalog No. 40. 4-M-4A

for Steam • Water • Oil • Gas • Air
Acids • Alkalies • Ammonia

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BELMONT
PACKING AND RUBBER CO.
Butler and Sepviva Streets
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Rings • Spirals • Coils • Reels
Spools • Sheets • Gaskets
There's a Belmont Packing for every service

Ever since you were knee-high to a hop-toad, you've heard about America's wonderful *natural resources*—the bountiful fertile fields, the towering timber growth, the boundless water power, and the untold wealth of gold, iron, oil, silver, coal and other natural treasures that lie buried in the ground.

Is it because America has *more* natural resources than any other country that Americans enjoy the world's highest standard of living? No—many countries have as much—some have more.

Then is it because Americans *do* more with what they've got?

Yes! And the reason is as plain as the nose on your face. It's because Americans are free to develop their natural resources—and their natural resourcefulness—in the wholesome climate of *open and strenuous* **COMPETITION.**

COMPETITION—not "regimentation"—is what eggs a man on to do his best.

COMPETITION—not government control—is what urges a business to give its customers ever greater value for their money.

So let's say "NO SALE" to the *ism* peddlers who would have us swap our U. S. A. system of free competition for their "planned" regimentation—trade our U. S. A. freedom and plenty for their serfdom and poverty!

* * *

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THE COMPETITIVE SYSTEM DELIVERS THE MOST TO THE GREATEST NUMBER

ENGINEERS' PREVIEW

(*Continued from page 108*)

DR. RALPH G. OWENS, 46, has been named dean of engineering at Illinois Institute of Technology, Dr. John T. Rettaliata, president, announced today. Dr. Owens has served as assistant dean of engineering since February, 1951. He replaces Dr. Rettaliata, who was recently named president. From 1946 to 1951, Owens was professor of mechanical engineering at Illinois Tech.

★ ★ ★

DEVELOPMENT and testing of combustion and process control systems and instruments will be a major function of the new research and development laboratory now nearing completion at Hagan Corp.'s Orrville, Ohio, plant, according to D. J. Erikson, president. The new laboratory will be known as the J. M. Hopwood Research Building in memory of the founder of Hagan Corp.

★ ★ ★

INCREASING demands point to a time when all the potential hydro capacity of the Southeast will have been developed, Clement P. Lindner, chief engineer, South Atlantic Division, U. S. Corps of Engineers, told the Spring convention of the ASCE.

"Electric companies and generating unit manufacturing concerns have been hard pressed to keep construction ahead of the demand," he said. Defense loads are growing rapidly and there has been no cessation in civil demand.

"The time may come in the not distant future when all the potential hydro capacity in the Southeast will have been developed, and it will have become necessary to seek additional capacity through other sources."

★ ★ ★

APPOINTMENT of E. C. Webb to vice president in charge of production and engineering for Iron Fireman Manufacturing Co. has been announced. Webb, a veteran of 22 years with the heating concern, has held the office of vice president in charge of research and development engineering since a year ago and prior to that was in charge of all service and field engineering in the United States and Canada. Webb is a member of the ASME and of the technical advisory committee on combustion for the ASH&VE. He is also a member and past-chairman of the engineering committee of the Stoker Manufacturers association, a member of the committee on engineering (commercial and industrial) of the Oil Heat Institute and of the Industry Advisory Conference for commercial-industrial equipment of Underwriters' Laboratories, Inc.

PROVOST Paul H. Buck announces the appointment of Dr. George F. Carrier as Gordon McKay Professor of Mechanical Engineering in Harvard University. His appointment is one of the first of several which are to be made in the Division of Applied Sciences to increase Harvard's coverage of the general area of mechanical engineering and the properties of materials. Dr. Carrier is now professor of mechanical engineering at Brown University, where his work has been in applied mechanics, especially in fundamental problems in elasticity and fluid mechanics. At Harvard, he will continue his work in these fields and will teach a course for graduates and advanced undergraduates in Strength of Materials.

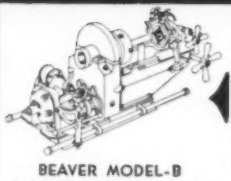
★ ★ ★

JOHN M. MARSTON of The C. O. Bartlett & Snow Co., is opening a Pittsburgh office for the company at 91 Central Square, Pittsburgh 28.

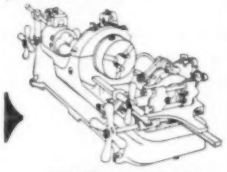
★ ★ ★

SYNTHETIC GRAVEL has been developed. The ingredients are soil, inexpensive chemicals, and sulphite liquor, says *The Ohmite News*. The "gravel" is made in briquetting machines and offers promise for solving road building and construction problems where natural gravel is scarce.

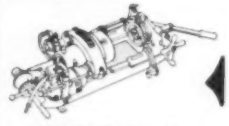
BEAVER—gives you a choice of 4 PIPE and BOLT MACHINES



BEAVER MODEL-A
A rugged, Heavy-Duty Machine. Range ⅛ to 2". Up to 12" with Geared Tools and Drive Shaft. Bolts ¼ to 2"—Weight 365 lbs.

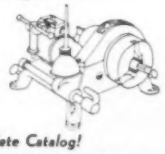


BEAVER MODEL-B
A Middleweight Utility Machine. Range ⅛ to 2". Up to 8" with Geared Tools and Drive Shaft. Bolts ¼ to 1½"—Weight 235 lbs.



BEAVER MODEL-E
A Lightweight Portable Machine. Range ⅛ to 2". Up to 8" with Geared Tools and Drive Shaft. Bolts ¼ to 1½"—Weight 185 lbs.

BEAVER MODEL-C!
A sturdy little Power Drive that converts Hand Tools into Power Tools—Range ⅛ to 2". Up to 8" with Geared Tools and Drive Shaft. Bolts ¼ to 1½"—Weight 140 lbs.



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Sign Your

DECLARATION OF INDEPENDENCE

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Buy U. S. Savings Bonds!

More and More Industrial Users Specify . . .

VACO

BREAK-PROOF
SHOCK-PROOF

Screw Drivers

Only Vaco Offers Such Uniformly High Quality... So Many Styles and Sizes ... At Such Low Overall Cost!

• Yes, industrial users everywhere . . . men who know quality, value and price in tools . . rely more and more on Vaco for every screw driver need. Made with electrically heat treated chrome vanadium steel blades and exclusive Vaco Amberyl fire-safe handles, Vaco products give more for the money . . . are low cost in the long run. Buying is easy, too, because there are more than 250 Vaco stock styles and sizes . . . all your regular, Phillips, clutch head, Reed and Prince, Klipxon, offset and specialty drivers from *one* source!

Another VACO "Special"—
Beryllium Copper Non-Sparking Drivers

The new Vaco Beryllium-copper screw drivers have found immediate acceptance where there is an explosion hazard. Nearly as strong as finest steel, yet completely spark proof, these fine drivers are durable as well as safe. Prices are conservative . . . full information on request.

FREE 32-Page Handbook-Catalog

Users of screw drivers have found the new 1952 Vaco catalog to be a veritable mine of information. Every major type of driver is illustrated. Complete tables give all useful application data including bit size, handle diameter and length, blade dimensions, screws to be driven, etc. Send for your free copy, *today!*

VACO PRODUCTS CO.
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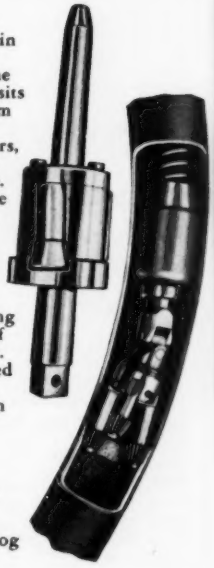
More Than 250 Screw Driver Styles and Sizes!

WILSONIZE

- ***to beat the clock on downtime***
- ***to get better tube maintenance***

Choked or clogged tubes lower the efficiency of your tubular apparatus . . . result in costly downtime. But, with Wilson Tube Cleaners on the job, even the toughest deposits are thoroughly removed from tubes of boilers, heat exchangers, stills, evaporators, etc. Tubes are left spic-and-span, ready for more service. And best of all, Wilson Tube Cleaners do their work in a hurry . . . help you beat the clock on downtime.



You get equally efficient service from Wilson Tube Expanders. They make rolling of new tubes . . . rerolling of old tubes . . . quick and easy. These precision-manufactured tube expanders insure solid seating. They are available in all sizes, flaring and non-flaring types.

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WILSON

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TUBE CLEANERS • TUBE EXPANDERS

Obituaries

ELMER H. HORSTMAN

ELMER H. HORSTMAN, 52, chief engineer for the steam turbine section of the Allis-Chalmers Manufacturing Co.'s power department, died of a heart attack at North Freedom, Wisc.

A graduate of Purdue University with a bachelor of science degree in mechanical engineering in 1923, Mr. Horstman joined Allis-Chalmers as a graduate training engineer. In 1924 he was assigned to the firm's steam turbine department. He became chief engineer of the section in 1948.

Mr. Horstman served as scientific consultant for the U. S. government in Germany in 1945 and 1946, as an investigator of power plant equipment on a leave of absence from Allis-Chalmers.

Mr. Horstman's affiliations included the ASME and the Engineering Society of Milwaukee.

HENRY RICHARDSON

HENRY RICHARDSON died on Sunday, December 2nd, 1951, at the age of 83. He was founder and chairman of the board of the Richardson Scale Co. Mr. Richardson was born in England on September 19, 1868. His father was a miller, and while working as a superintendent of his father's plant he noticed the weighing errors that crept into the work of employees. That gave him the inspiration for his development of the automatic scale.

HENRY RICHARDSON

British rights to manufacture this scale were sold to Avery Scale Co., of England. In 1902 Mr. Richardson started the manufacture of automatic scales in America.

Mr. Richardson was also very active in civic affairs, providing playgrounds for the children, founding the Athenia Boys Club, being a member of the Board of Governors of Passaic General Hospital and a former president of the Clifton Chamber of Commerce.

EDWARD N. STRAIT

EDWARD N. STRAIT, 66, electrical engineer, pioneer in public utility regulation, died in December from coronary thrombosis. For thirty-four years, Mr. Strait was manager of the Rate Research Department of Pioneer Service & Engineering Co. and predecessor companies, retiring in May, 1950. He served the Wisconsin Railroad Commission as rate and valuation engineer from 1907 to 1916, being chief statistician upon leaving.

He was a member of the Illuminating Engineering Society and the Western Society of Engineers. During World War II he was on loan to the War Production Board. He was past chairman and for many years a member of the Rate Committees of the Edison Electric Institute and the American Gas Association.

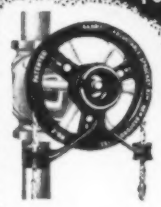
WALTER P. BERG

WALTER P. BERG, vice president and director of Dravo Corp., died suddenly in a Pittsburgh hospital, February 3, at the age of 60.

Associated with Dravo Corp. for 30 years, Mr. Berg also was a member of the firm's Executive Committee and general manager of the Machinery Division. In addition, he was president and director of Dravo-Doyle Co., and a director of Union Barge Line Corporation, Tri-Lok Company and Southern Transfer Company, Memphis, Tenn.

POSITIVE! EFFICIENT! SAFER!

VALVE CONTROL AT LOWEST COST!



Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

INSTALLED, AND OPERATING, IN ONLY A FEW MINUTES

Range of 10 ADJUSTABLE sizes fits all valve wheels, with rising or non-rising stems, from 2 to 30 inches diameter.

●

Distributors in principal cities, or send for Catalog Folder PE-2 and name of nearest distributor.

● Here's easy, convenient, instant control of overhead, out-of-reach valves—right from the floor! No expensive apparatus, no switches, nothing to break down when needed most! BABBITT Adjustable Sprocket Rim with Chain Guide is installed in a few minutes, and gives you positive, efficient valve control. Low initial cost is last cost! Prevents accidents, prevents waste, saves money!

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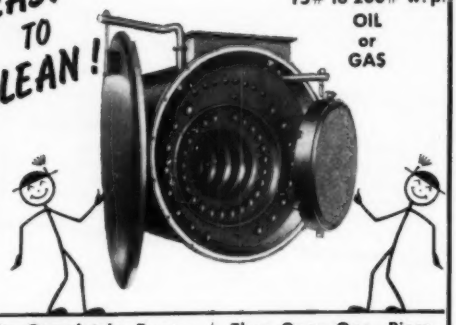
AMESTEAM GENERATOR

EASY TO CLEAN!

10 to 500 h.p.
15# to 200# w.p.
OIL or GAS

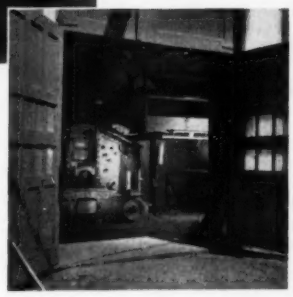


To Completely Expose Furnace and All Tubes . . . Open One-Piece Rear Flue Cover . . .

Then Open One-Piece Rear Baffle. There are Ample Clean-Out Doors in Front End, too!

AMES IRON WORKS
BOX M-5, OSWEGO, N.Y.
Builders of Better Boilers Since 1848

Johnson-March system turned off at hammer-mill crusher in a large eastern plant. Note volume of dust. Compare this unretouched photo with the picture below.



This unretouched photo shows a Johnson-March system operating at the same crusher. Note absence of dust while coal is being crushed at rate of 250 tons per hour. These systems have proved themselves in many plants. We'll be glad to furnish names and addresses.

STOP COAL DUST

at 1/10 the usual cost!

If you have a dust problem—no matter how large or small—no matter where the dust occurs . . . car dumpers, hoppers, crushers, belt galleries, or coal pile—it can be controlled or eliminated with a Johnson-March system. Installation is fast, simple and inexpensive. There is no interference with normal plant operations.

No ducts, no fans and no cumbersome equipment are required. Johnson-March compounds added to water and a carefully engineered spray system do the work. The system is most effective, and its operation is so simple. It costs far less than other types of dust handling systems—on the average, only 1/10 as much. And maintenance costs next to nothing!

Even though you may have a mechanical dust collecting system, it will pay you to investigate a Johnson-March system.

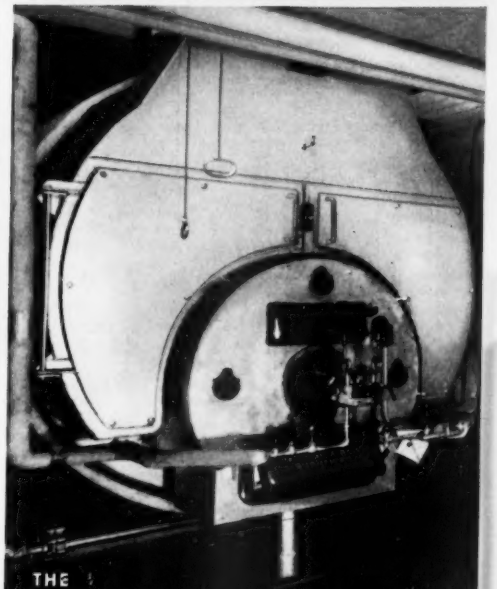
Without cost or obligation, why not have one of our engineers discuss your dust problems with you? Just drop us a line.

Johnson March

Specialists in Dust Control

Dept. PE-1 • 1724 CHESTNUT STREET • Phila. 3, Pa.

TEAMED FOR *Economy* . . .



THE "SCOTCH MARINE" BOILER

. . . and the NATIONAL AIROIL TANDEM COMBUSTION UNIT

For top fuel efficiency, the "Scotch Marine" type boiler deserves to be "specially" fired. We of NATIONAL AIROIL recommend our popular Tandem Combustion system as a fitting supplement to this boiler. HERE'S WHY: the Tandem Combustion Unit consists of two specially designed refractory combustion muffles of different diameters placed along the same centerline; secondary air is more accurately controlled, in fact, the Tandem Unit actually creates some of its own draft needs . . . allowing easy adaptability to an infinite variation of load requirements. The flame can be shaped to fit the combustion chamber, which reduces scale formation, flame impingement and smoke. The NATIONAL AIROIL Tandem Combustion Unit is truly economy assurance for the "Scotch Marine" type boiler. Our engineering consultation is at your service.

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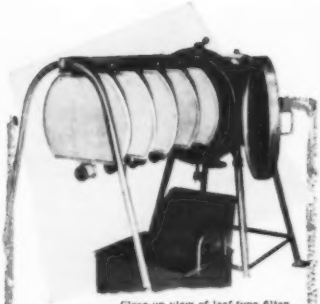

Close-up view of leaf-type filter used with Sorbo-Cel by Pullman-Standard

How Pullman-Standard operates boilers on a

1% blow-down basis...

with SORBO-CEL

At the Haskell & Barker plant of Pullman-Standard Car Mfg. Co., Sorbo-Cel solved the major filtration problem of removing oil from condensate returned to the two new 50,000 lb-per-hr 400 psi, 750-F boilers.

Pre-Coat Sorbo-Cel and regular Sorbo-Cel, specially processed high flow-rate diatomaceous silica powders, are used on leaf-type filters. After a film of Pre-Coat Sorbo-Cel has been built up on the filter screens, regular Sorbo-Cel is added continuously to the unfiltered water. This means a new filter surface is constantly presented to the oncoming water.

Results . . . Water filtered by Sorbo-Cel contained less than 0.1 ppm of oil . . . and boilers have since been operated on a *one per cent* blow-down basis.

Send coupon below for bulletin giving data on this low-cost way to remove oil from water. No cost or obligation.

JM

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Johns-Manville
Box 60, New York 16, N. Y.

Please send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

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CHIMNEYS . . .
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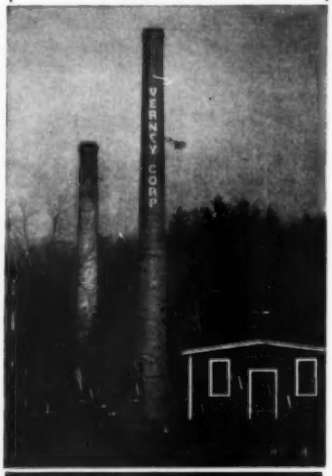

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MECHANICAL ENGINEER

Experienced mechanical engineer with steam background capable of engineering, selecting equipment and designing steam plant, auxiliaries and distribution system. Electrical experience also desirable. Location, south. Write complete qualifications in first letter, including references and salary desired. Details confidential. Box 1667, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Illinois.

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Retired Engineer with 42 years of most practical experience as chief engineer of well-known Middle West utility company will accept consulting assignments. Has done much work in field of handling and burning low rank bituminous coal and lignite, centralized control of power plants, general power plant operation. Fellow ASME, Fellow AIEE. Box 1665, POWER ENGINEERING, 110 S. Dearborn St., Chicago 3, Ill.

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High Pressure Rubber Gaskets
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POWER PLANT
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UTILITY • INDUSTRIAL • CHEMICAL
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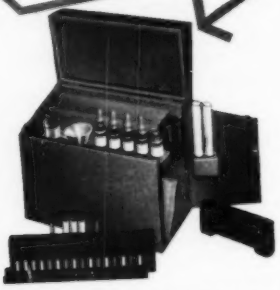
BOILER WATER CONTROL SIMPLIFIED!



with Taylor Comparators ...for pH and phosphate determinations

Easy to use—accurate results in only 2 minutes—no fragile single standards to handle—no laboratory training necessary—these and many more advantages are yours when you use Taylor Comparators for determinations of boiler water pH, high and low phosphate, polyphosphate, nitrate and other determinations. All sets are complete with color standard, base, slides, reagents and accessories. Practically all slides work on same base.

COLOR STANDARDS GUARANTEED!

There's no danger of mechanical inaccuracies when you use Taylor Comparators because all Taylor liquid color standards carry an *unlimited guarantee against fading*. Further, each complete set of color standards for any one determination is mounted in a sturdy plastic slide to practically eliminate the problem of breakage.

SEE YOUR DEALER

for Taylor Comparators. Also ask about the Taylor Hardness Set which substitutes a simple titration for old, time consuming soap tests.

WRITE DIRECT for free handbook describing colorimetric methods and Taylor equipment for control of pH, chlorine, phosphate, etc., in 34 basic industries.

W. A. TAYLOR AND CO.
410 RODGERS FORGE RD. • BALTIMORE 4, MD.

CHAPMAN

Steel Valves Score on all 3 Points

1

CHAPMAN STEEL VALVES have the high precision ratings of custom-made valves — but the economy of production-line manufacture.

2

CHAPMAN STEEL VALVES are made exclusively from quality-controlled steels developed and produced in Chapman's own foundries under control of Chapman's own outstanding metallurgists.

3

CHAPMAN STEEL VALVES are designed to equal or surpass — A.S.A. and A.P.I. Standards in all pressures and temperature ranges.

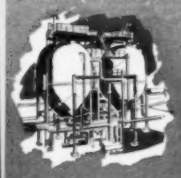
Be sure to see Chapman first whenever you need steel valves — gate, globe, angle or check. As a result of Chapman's long years of research and experience, they are tops in every respect.

The Chapman Valve
MANUFACTURING COMPANY
INDIAN ORCHARD, MASS.

DEAERATED COOLING WATER SAVES ONE COMPANY

$85,500 a year!

THESE BASIC PROCESSES, PLUS PERMUTIT SKILL, CAN SOLVE YOUR WATER CONDITIONING PROBLEMS



1. SLUDGE BLANKET HOT LIME SODA. Application of the sludge blanket to hot lime soda treatment reduces silica in boiler feed make-up, produces high quality steam.

2. HOT ZEOLITE—PERMUTIT Q. Subsequent treatment of water from hot lime soda treatment yields effluent of zero hardness. Permutit Q, or styrene base mineral resistant to high temperatures, replaces second stage phosphate treatment.

3. SILICA REMOVAL PLUS DEMINERALIZATION. Demineralization by cold ion exchange processes produces water comparable to distilled water only at a fraction of the cost of distillation. Treatment by anion exchange resin, Permutit S, reduces silica to less than 0.2 ppm.

4. DEAERATING HEATER. The Permutit Deaerating Heater, utilizing exhaust or bled steam, prevents corrosion of feed lines, stage heaters, economizers, and boilers, by removing oxygen and free CO_2. Capacities from 12,000 to 1,400,000 pounds per hour are in service.

5. PRECIPITATOR. The Permutit Precipitator is used to lower alkalinity, reduce hardness, and help to remove turbidity, color, taste and odor. It can also be used to reduce silica.

REDUCES CORROSION RATE 90%
PREVENTS TUBERCULATION
CUTS TUBE REPLACEMENTS
LOWERS WATER CONSUMPTION

A chemical company in California installed a Permutit 5,000 gpm Vacuum Deaerator just over 2 years ago. Now here's what they have to say about it after exhaustive checking and comparison.

"The benefits occurring from water deaeration are difficult to calculate in their entirety, since so many of the advantages in small items such as clean water lines, better operation of valves, less frequent water line replacement and better water flow cannot be easily assessed. However, the major corrosion costs in this plant . . . have been determined and compared with the cost of deaeration . . ."

And the report goes on to cite actual net savings of $85,500 per year resulting from the installation of a Permutit Vacuum Deaerator.

Find out how Permutit can solve *your* water problems. Write to The Permutit Company, Dept. **PE-5,** 330 West 42nd Street, New York 18, N. Y., or the Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

PERMUTIT®

WATER CONDITIONING HEADQUARTERS FOR OVER 38 YEARS